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SOME TENDENCIES IN THE DESIGN OF ELECTRICAL APPARATUS.

The Electrical Exhibition, now in progress in New York City, brings together under the same roof machines of small and moderate sizes of a large number of different makes, and gives an excellent opportunity for comparing the various features of the different designs and drawing conclusions as to the tendency of modern practice in this line.

In the design of direct-current dynamos there is evident a still increasing partiality for the multipolar as opposed to the bipolar type, the multipolar machines being made in sizes as small as one-half-horse-power at low speeds. These machines are uniformly of the circular type, that is, having external circular yokes and internally projecting poles.

In the construction of fields the rage for steel seems to have subsided, cast iron being quite largely used for the yokes, with cores—or at least pole tips—of wrought iron plates or laminations about one-eighth to one-quarter of an inch in thickness. The practice of casting these into yokes is about equally in favor with that of bolting the parts together with machined joints. The yokes are noticeably thinner and wider than was the practice hitherto, being now as a rule sufficiently wide to cover completely the windings of the fields, so that on looking at the machine from one side the field spools are invisible. The purpose of this is probably mechanical protection simply, the same principle being carried still further by some makers in what is called the "apron type field," this designating a yoke which is flanged at either edge inwardly toward the shaft, thereby still further enclosing and protecting the coils. Generator fields are universally compound wound, edgewise tape winding, particularly for series coils, beginning to appear in this country.

Coming to the air gap a notable feature is the increase of the magnetic density at this point, the use of pole shoes to increase the area of the gap in order to reduce the reluctance having been quite largely abandoned. On the contrary, many makers now bevel the poles of the field magnet cores, thereby reducing the active area of the gap below that of the cross section of iron in the field. This, with the area lost by reason of the crowding of the lines of force into tufts over the teeth of the armature, obviously increases the density greatly above that in the iron of the fields. The purpose of this is to reduce the distortion under load, the lines benig so crowded at the pole faces that the distorting effect of the armature currents cannot crowd them much more into either horn. This is obviously done at the expense of an increased loss of energy in the field exciting coils, but the demand for a machine that will run sparklessly without rocking of the brushes from no load to 25 or 50 per cent. overload necessitates some such sacrifice.

Coming to the armatures the smooth body type has practically vanished from the design of the present day. The notches are deep, about one-half the width of the teeth, and as a rule with parallel sides, the teeth being narrower at their bases than at their tips. The edges of the laminæ are finished after assembling, to remove burrs and irregularities in the slot walls. Binding wire is still quite largely used, but other methods of resisting the centrifugal force are coming into practice, one popular one being the insertion of long strips of wood the whole length of the slot, entering notches just beneath the tip of the teeth binding them firmly in place. Some makers use an overhanging tooth with but a very slight gap

between the overhanging tips of adjacent teeth, making practically a tunnel winding, thus eliminating the tufting of the lines of force across the air gap and the consequent necessity of laminating the poles, as well as the need of any binding devices, at the expense of greater difficulty in armature winding. In armature insulation the use of mica and its products has fallen off, owing undoubtedly to the expense of such materials and the production of cheaper insulating materials, such as oiled paper, pressboard, sheet fibre, etc., with sufficiently high breakdown strength for the voltages common in direct-current constant-potential work. Straight out end connections or barrel windings are apparently growing in favor, being now used as much as the older spiral type.

In commutators little change is to be found, the only material modification at all popular being the use of segmentally divided tightening rings, with a plurality of clamping bolts in place of the plain screw and nut concentric with the shaft, this being a modification rendered necessary by the increased size of machines. Commutator diameters are increasing, a change rendered necessary to keep the voltage per segment down with the increased number of poles, but the face or length of the commutator remains about as before, the increase in the area of the brush contact per ampere being quite noticeable.

The carbon brush is supreme, even for 100-volt machines, and is uniformly made of the radial or nearly radial type. Great advances in the construction of brush holders are noticeable. What is known as the reaction type or the Baylis holder has been adopted by various makers with astonishing rapidity, this term signifying a holder in which the brush lies loosely against a copper bearing and contact piece on one side and the commutator on another and is forced against both by a lever held up by a spring. The brush is not clamped in place at all, and as a rule is not even surrounded by a retaining structure, so that it can be lifted out with the fingers with perfect freedom while the machine is running. Machines not using this brush holder almost invariably use a flat copper braid or heavy flexible cord, popularly known as a "pig tail," riveted into a clamp or casting on the brush, for increasing the conductivity to the main leads. This has not as yet appeared on the reaction type, although it would appear that the conductivity between the brush and holder with this type would need some such help more than would any clamped brush. Another commendable brush holder attaches the clamp to the base by a parallel motion device consisting of four links made up of bunches of thin leaves of sheet copper. Brush holder rigs and rocker rings are becoming more and more massive and simple, most constructors favoring a pair of rings, one for each polarity, serving both for mechanical support and electrical conductivity, thus requiring no cross connecting cables. These rings are fastened to the magnet yoke rather than to the outboard bearing in all up-to-date machines.

Motor starters show the greatest development of any apparatus since the last exhibition held two years ago, the aims of designers outstripping now the much criticised requirements even of the fire department and the underwriters' committees. Some motor starters show attempt to provide even against carelessness, ignorance or willful abuse on the part of the operator. Special controllers for motors used for particular purposes, such as printing press and elevator service, show great improvements in solidity and simplicity of design, considering the added automatic devices. Motor switches and rheostat arms are as a rule interlocking, and either one or the other or both are fited to act as circuit breakers in case of overload or under voltage. Two general methods are widely used for the magnetic part of the instrument, one consisting of a release magnet differentially wound with two coils respectively in series with the shunt field and the armature circuit of the motor, the currents in the two coils tending to neutralize each other's magnetic effect. Normally the magnetization set up by the shunt current is sufficient to retain the rheostat arm or switch trigger, whichever is used, but in case of overload, the current in the winding connected with the armature circuit neutralizes the effect of the other to such an extent that the device is released. In case of cessation of supply the magnet of course releases, as both circuits are dead, and in case of under voltage the effect of the shunt winding weakens, allowing the series winding to release the device with a smaller overload and even on normal or low loads, a valuable feature, as it protects the motor against sparking due to increased armature distortion with weak fields. The other widely used arrangement of magnetic release devices consists of a magnet, the winding of which is in series with the shunt-field coils of the motor, used to retain the release arm or trigger, and another magnet or relay, wound with a coil in the main armature circuit, fitted with a weight on its armature to adjust it to various currents and acting when its armature is pulled up by an overload to short circuit the winding of the main release magnet. This arrangement obviously gives protection against overload and cessation of supply, but does not give the same protection against abnormal distortion on under voltage that the differentially wound device assures.

As far as one can judge while within the four walls of the exhibition, the open arc lamp is a thing of the past, enclosed lamps for both direct and alternating current constant potential work and pressures up to 250 volts, as well as for series circuits, giving brilliant evidence of their success in every direction. The control of these lamps is, as a rule, effected by a series magnet with an armature having a large range of motion with a limited variation of current, controlling a clutch which lifts the carbon. This arrangement lowers the carbon gradually as the arc lengthens and the current weakens, until the desired limit of the armature motion is reached, at which point the clutch is arranged to let go, dropping the carbons together momentarily and pulling them apart immediately thereafter This action gives a "wink" to enclosed arc lamps at intervals of about half an hour, the burning of the carbons being, of course, much slower than in open arcs. Some of the latest designs of regulators are designed to avoid this winking.

The use of belting still decreases, the direct coupling of prime movers to generators, as well as motors to their work, being the practically universal rule in spite of the almost overwhelming difficulties in many cases.

Among the minor points likely to call forth the approbation and the remark, "Why did no one do it before?" from the visiting engineer at the exhibition, on account of their peculiar fitness, are the following: A plate glass switchboard; series coils of compound-wound generators connected in multiple with each other; a two-filament series multiple lamp for 110 or 220 volts, or double life at one-half candle power; electric heating fans; a motor brake operated by hinged field magnet yokes with no flux across the joints, and lamps with the upper half of the bulbs silvered to increase the downward radiation.

The most striking developments of electrical engineering, namely, those connected with the mammoth sizes of machines now used for long distance power transmission and for heavy railroad work and large railroad systems, are not in evidence at the exhibition, owing to the unwarranted expense involved in placing such machinery for a short exhibit and the absence of the two largest electrical manufacturing concerns from the list of exhibitors. In spite of this handicap the exhibition is of remarkable technical interest, and specialists in any line will find much more to interest them than the few points detailed above.

Oscillatory Currents and Some of Their Phenomena—III.

BY PROF. E. F. NORTHRUP.

PRACTICAL HINTS FOR CONSTRUCTING OSCILLATOR.

The chief and almost the sole difficulty encountered in the construction of efficient oscillatory current apparatus of reasonable size is in obtaining sufficient and permanent insulation. The liking of a high-potential high-frequency current for any path of discharge beside that between the terminals will often drive the experimenter to despair. A few general facts therefore in regard to the subject of insulators and insulation will not be out of place.

As Professor Fessenden has pointed out in a recent paper read before the American Institute of Electrical Engineers and printed in THE ELECTRICAL WORLD April 2, 1898, we may speak of an insulating substance as that which will more or less effectually prevent a slow leakage of the electric current or as a substance which, permitting more or less leakage, will prevent a disruptive or sudden discharge. These two aspects of an insulator may be very prettily illustrated as follows: Provide a glass tube about an inch in diameter with a tight fitting cork for each end. Insert a pointed wire through each cork, so that the two wires will come within the tube and be capable of meeting at its centre. Fill the tube with ordinary water and pull the two ends of the wire a short distance apart. If a high-frequency high-potential current source be attached to the ends of the wires outside the tube, it will be found that the water has considerable insulating power against a disruptive discharge. When the ends of the wires are sufficiently near, however, the discharge will pass through the water, giving a beautiful light. It will be observed, also, that bubbles come off everywhere from the sides of the wire. These show that considerable current is flowing through the water in the ordinary way, while the water is behaving as a highly insulating substance to the disruptive discharge. After the water becomes thoroughly fouled no disruptive discharge can be obtained, the current all passing through the water by electrolysis. The kind of insulation required for oscillatory currents is that which will prevent the disruptive discharge. For reasons to be shown an insulator may have enormous strength for an E. M. F. which acts for only an instant and yet be very weak for the same E. M. F. applied for a considerable time.

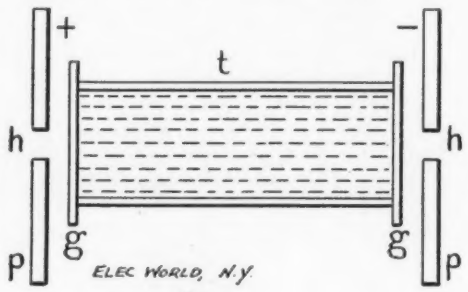

FIG. 11.

An experiment first performed by Faraday will teach us much about insulators. The experiment is illustrated in Fig. 11. *p p* are two circular brass plates with small holes *h h* in their centre. *t* is a tube with glass ends *g g*. Such a tube Faraday filled with carbon bisulphide and a great many short pieces of silk thread. By applying the eye to one of the holes *h h* he could not see through the tube because the short pieces of silk were turned in all directions. When, however, *p p* were given opposite charges of electricity the threads all arranged themselves in line and he obtained clear vision through the tube lengthwise. This shows that the silk is a better conductor of the lines of electric stress than the liquid in the tube. Now assume the silk to be also a poorer insulator than the liquid, and that the difference of potential of the two plates is so great that a discharge is just on the point of taking place between the plates through the liquid alone. At the first instant that the plates are charged the particles, supposedly of weak insulating power, will not be lined up, but after a greater or less time they will become so, when the path for the current to pass through being weakened by this alignment of the particles the discharge will occur. Thus we have one case in which an instantaneously applied E. M. F. would not break down an insulator, while one longer applied of the same value would. The same will hold true in a like measure if the two plates are being alternately charged with electricity of opposite signs. Now there are few oils or other insulating liquids which are perfectly pure and free from foreign particles, and the very effect here described often takes place, especially with high-potential currents of a moderate frequency. I have found oil, which had an instantaneous insulating value for the current from a high-potential transformer several times stronger than air, prove actually weaker than air for a long applied electric pressure. By making the insulator a solid we ought to prevent this polarization of the particles, but, with high-frequency currents, we fall in two other difficulties which are harder still to eliminate.

Almost all solids become conducting when hot, glass, for example, being an excellent conductor when melted.

Now it is a well-known fact that a high-potential high-frequency current will eat its way through the best of solid insulators a distance that it could not begin to penetrate at once, and that, too, when no air is present, the terminals being perfectly imbedded in the solid insulator. My own conception (formed probably by reading Professor Fessenden's article on insulators) of one cause of this will be made plain by referring to Fig. 12. Let *P* and *P'* be two metal plates of indefinite area. Suppose black fibre to be an insulating material between these plates and suppose this to be impure, having particles of some better insulating substance, but of higher specific inductive capacity than the fibre imbedded in it. Let *p*, *m* and *n* be three such particles. If *P* is charged positive and *P'* negative the lines of electric stress, finding an easier passage through these particles, will be bent out of their course somewhat, as shown in the diagram. Since a charge of electricity is nothing but the locus of the ends of such lines of stress, *p*, *m* and *n* will have by induction small apparent charges of electricity upon their ends, as indicated in the diagram. Suppose *m* and *n* are near enough together so that a discharge may pass between their approximated ends. Now if *P* and *P'* are charged to a steady potential, such a discharge between the particles taking

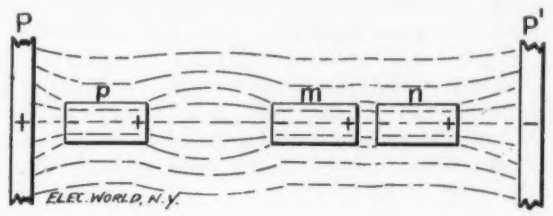

FIG. 12.

place but once might produce no visible effect, but if the two plates are rapidly charged alternately positive and negative by means of an oscillatory E. M. F. the discharges between the particles would be rapidly repeated, and since heat is always the accompaniment of discharge the insulating medium about the particles would become heated and thereby greatly weakened, so that the local discharges in its substance would become more and more numerous, and finally the discharge would find its way directly from plate to plate. Very few solids are so homogeneous that the above effect will be entirely absent. Substances which readily conduct lines of electric stress or, as the term is, have a high inductive capacity are usually very poor insulators for oscillatory currents. High specific inductive capacity may be a quality inherent to the substance itself or merely a result of impurities scattered through the substance. Referring to Fig. 12 we may suppose that the insulating medium between the plates is solid sulphur, which has a small specific inductive capacity, that is, it conducts lines of electric stress only a little better than air does. Suppose now the particles, such as *p*, *m* and *n*, to be of metal and extremely numerous. The lines of electric stress would find an easy passage through these particles and the actual path which they would have to travel through sulphur would be small, hence the sulphur would appear to have a great specific inductive capacity. In this case, however, the apparent specific inductive capacity is obtained at the expense of dielectric strength. It would therefore be folly to use such a contaminated substance as an insulator between the metal plates of a condenser. The apparently high specific inductive capacity of the substance would make the capacity of the condenser great for its size, but only at the expense of insulation. The apparent specific inductive capacity of many substances may be greatly lessened by drying out the moisture which is occluded in the pores.

Aother potent cause of dielectrics or insulators breaking down

under a continued strain of rapidly alternating potentials is what Tesla terms molecular bombardment. To observe this effect fill a box containing a high-frequency high-potential coil with a very viscous insulator, as a mixture of resin and machine oil. Place in the bottom of this box a piece of asbestos or any substance which contains a quantity of air in its pores. On account of the thickness of the insulating compound this air would ordinarily remain permanently entrapped. When, however, the coil is in action the air bubbles are agitated with great violence. They heat the insulator surrounding them and soon work their way to the top of the box through a substance so thick that a stick could hardly be pushed into it. It is useless to try to insulate high-frequency currents with homogeneous solids unless every trace of air can be avoided, for this molecular bombardment, which heats and destroys the insulating property of the solid, will eventually destroy success. Tesla remarks that a solid insulator containing a particle of air will in time be as surely eaten through by the high-frequency discharge as a stone let go will fall to the ground.

I have observed another property of insulators for high-potential high-frequency discharges which is quite remarkable, and which I shall not here attempt to explain, but merely to state the fact as I have observed it, hoping only that some experimenter will investigate the matter thoroughly. A high-frequency coil was constructed with a separation between the primary and the secondary which was calculated as being quite sufficient to prevent breakdown when machine oil was used as the insulator. It was thought that the insulating power of the oil would not be lessened by dissolving pure resin in it. This was accordingly done, the proportions being such that when the mixture became cold it would scarcely flow, but yet was not a solid. This mixture when very hot was poured over the coil, which was immediately set in operation for two hours without a sign of a breakdown. Every particle of air had been expelled, and yet when the coil was tried the following day under exactly similar conditions, except that the insulator had become cold, it broke down in many places between the primary and the secondary coils. This observation leads me to believe that under certain conditions a substance becomes a better insulator as it is made more fluid, though the fluidity is gained by raising the temperature. I may add that tests show that the more fluid oils are much better insulators for high-frequency high-potential currents than the thick oils, kerosene being especially superior.

It is a remarkable fact that while engine and other kinds of oil may be taken as from eighteen to twenty-four times as strong as air for the high-potential high-frequency currents, it can only be taken as about equal to air for the discharge from a high-potential transformer capable of giving an inch discharge through air. (See The Electrical World, April 2, 1897.) Solid dielectrics, such as a mixture of beeswax one part and resin three parts, or resin softened a little by a small portion of engine oil, hold up the high-potential slowly alternating E. M. F. of a high-potential transformer much better than oil, while the reverse holds true with high-frequency E. M. Fs.

Micanite is the best all around solid dielectric to employ where it can be used with slowly alternating E. M. Fs. that I have found. A sheet 1-1000-inch thick will hold up about 1000 volts if it does not become heated. The best solid dielectric for slowly alternating E. M. Fs., which can be melted and poured over the parts of the apparatus, is resin with a very small portion of a good quality of engine oil melted with it and thoroughly stirred in. Paraffin that has been heated a long time is also very good. For the high-frequency currents I would recommend after much experimenting a good quality of clear, well-strained engine oil, and that it should be heated quite hot before being poured over the apparatus. Oil is the only insulator for these currents which can be counted as safe for all time. As a rule it is advisable to avoid the use of substances which have a high specific inductive capacity. A 5-inch high-frequency discharge will quickly eat a hole through an eighth of an inch of glass.

I will now give a somewhat detailed account of how to construct the separate parts of a high-frequency apparatus which will run on a 104 or a 52-volt alternating-current city circuit, and be capable of giving a copious high-frequency discharge 8 inches long. The apparatus will be especially designed with a view to exciting X-ray tubes.

It is often customary to use an ordinary induction coil for the high-potential transformer. If such is used the condenser is cut out of circuit and the primary of the coil connected through an inductive resistance to the alternating current mains of the lighting circuit. An induction coil, since it has an open magnetic circuit, is an extremely inefficient form of transformer to employ. There is moreover a very important reason why it is desirable to employ a transformer of high efficiency. When resistance is thrown in circuit with the primary of the induction coil the effect on the discharge across the gap in the circuit of the condenser is merely to shorten it. The high frequency discharge is likewise shortened, but is of the same thickness or quantity. If, however, the transformer is of an efficient type, adding inductive resistance to the primary has the curious effect of causing the discharges in the condenser circuit across the gap to take place less frequently and the high frequency discharge, while remaining of the same length, is much thinner, and, by a proper adjustment of the inductive resistance and of the length of the spark gap in the condenser circuit, the high frequency discharge may be made to assume the appearance of a discharge from a Holtz machine or to become so fine and threadlike as to be scarcely visible. This ability to adjust the thickness of the high frequency discharge without changing its length has great value in working with X-ray tubes.

In Fig. 13 is shown a design of an efficient form of a high-potential transformer, which experience has shown to be admirably adapted to the work for which it is intended. Consideration has been given to cheapness and ease of construction. The secondary requires but 3 pounds of double silk covered No. 32 wire. It is intended to be used on an alternating circuit of about 125 alternations

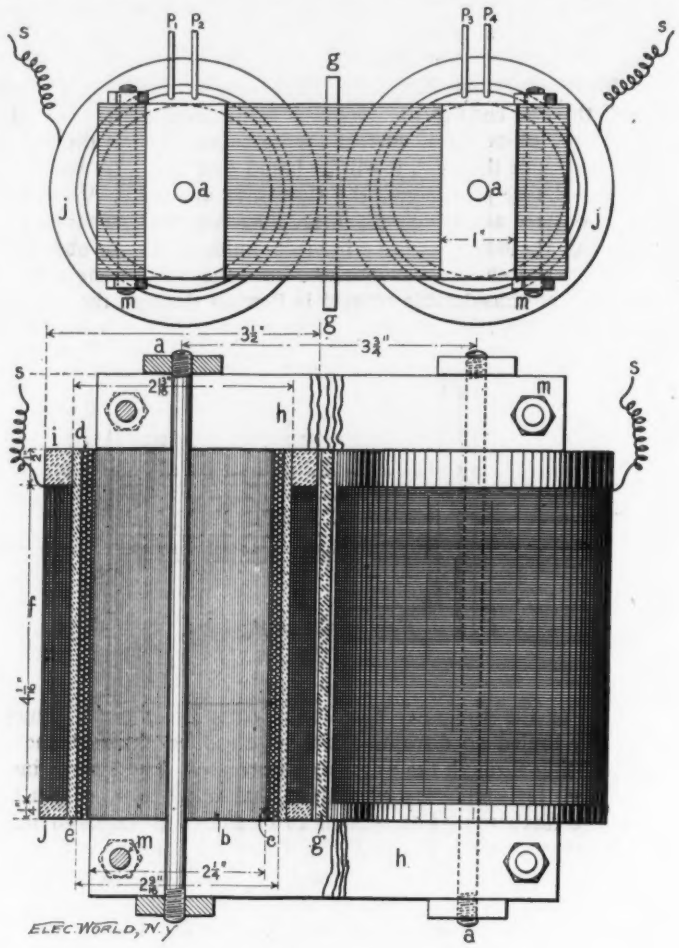

Fig. 13.

A = plan, B = section of elevation.

$a\ a$ = bolts, $b\ b$ = iron cores of No. 16 soft annealed wire.

$c\ c$ = paper insulation $\frac{1}{32}$ of an inch thick.

$d\ d$ = space for primary winding. This consists of 115 turns on each half of transformer, of No. 15 magnet wire wound in two layers.

$e\ e$ = micanite tubes $\frac{1}{16}$ of an inch thick to insulate secondary windings from primary.

$f\ f$ = space for secondary windings which are wound in 26 sections for each side, 52 sections in all. Sections $\frac{3}{32}$ of an inch thick, $\frac{1}{16}$ of an inch of fiber insulation between each section. Depth of secondary winding may be increased if greater E. M. F. is required. Use double silk-covered No. 32 wire.

g = glass plate to prevent a discharge between the two halves of the transformer.

$h\ h$ = iron yokes to complete magnetic circuit. These yokes should be built up of iron strips one inch wide and not over $\frac{1}{16}$ of an inch thick and bolted together with bolts $m\ m$.

$i\ i$ = red fibre or micanite rings.

$j\ j$ = red fibre or micanite rings.

$p_1\ p_2\ p_3\ p_4$ = ends of primary windings, which may be connected in series or multiple.

$s\ s$ = ends of secondary winding.

per second. By connecting the primary coils in series or in parallel it may be used on 104 or on 52 volts. An inductive resistance should be constructed to be connected in circuit with the primary of the transformer. If the condenser with which the transformer is used has the capacity of the one to be described the inductive resistance should consist of a closed magnetic circuit having two square inches of cross section of iron and 200 turns of No. 12 wire so arranged that more or less of the turns may be thrown in or out of circuit according to the voltage of the supply circuit and to the thickness of the high-frequency discharge which is required. The construction of the transformer will be plain from the description printed below the diagram. Since for insulating these high potential low frequency potentials micanite gives the best results of any thing which I have tried, it is worthy of remark that the firms which

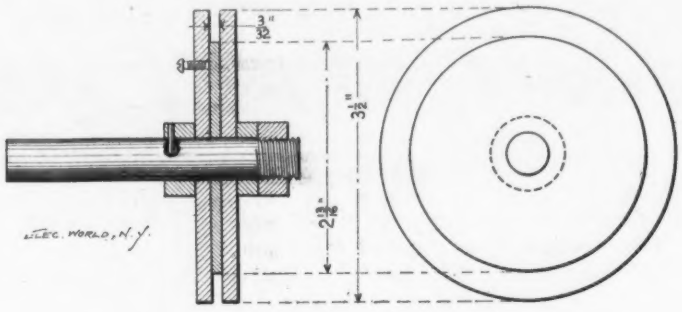

FIG. 14.

manufacture it will furnish it in most any conceivable form. It may also be remarked that black fibre should never be used, as it is useless as a high insulator. The red is much better, but is far inferior to micanite.

It is absolutely essential that the secondary of the transformer be wound in a large number of sections, and that these be thoroughly insulated from each other. The sections may be conveniently wound on a form like that shown in Fig. 14. The wire as it is being wound upon the form should run through a hot wax compound so that the coils will hold together when taken out of the form. Beeswax one part and resin four parts makes a very suitable wax. If the form is well oiled before the wire is wound upon it the coils will readily come off the form. The sections may be insulated from each other by rings of red fibre, one-sixteenth of an inch thick. The spark length of the transformer is about double when the condenser is placed in parallel with the gap. Three-eighths of an inch with the condenser connected in is sufficient for all practical purposes. If, however, a greater E. M. F. is required the sections may be wound a little deeper than those indicated in Fig. 13.

It is generally supposed that to obtain first-class oscillations and hence a smooth secondary discharge that the discharge across the gap in the condenser circuit must be blown out by a strong air blast or in some way mechanically interrupted. If, however, the capacity of the condenser is correctly proportioned to the transformer and a double discharge gap is employed the discharge will be automatically interrupted, and the oscillations will be as perfect without as with artificial interrupters.

A good condenser to go with the above transformer may be made as follows: Select about thirty sheets of a good quality of double thick window glass and examine these for flaws, casting out all defective sheets. For an eighth-inch discharge apparatus a suitable size for these sheets is 15 x 8½ inches x ⅛-inch thick. Very thin sheet copper or brass makes the best conducting material to use between these plates. The margin of glass between the edge of the copper and the edge of the glass along the sides of the plates should be one-half inch and the margin at the end of the plates should be 1 inch. At the other end the metal sheet may project one-half inch beyond the glass. Prepare a mixture of resin and oil by melting the resin and stirring into it a small quantity of engine oil. The proportions should be such that when the mixture is quite cold it will be hard, but not brittle like pure resin. Now dip one at a time all the metal sheets in the hot mixture so as to give them an even coating of the compound, and stack up the condenser. Hold the condenser plates in place with a light framework of wood. Place the condenser in an iron pan a little larger than the plates and about 5 inches deep. Fill the pan with the melted resin and oil and keep the whole hotter than boiling water for an hour or so, and press upon the condenser plates from time to time so as to expel as far as possible all air from between the glass plates.

When the air has been removed take the pan off the fire and allow the contents to become quite cold. Then by heating the pan on the outside with a gas flame the condenser will slide out as a solid cake. With a chisel the superfluous wax and the wooden frame are easily removed. The ends of the metal sheets which project beyond the ends of the glass plates may now be bent over flat and soldered together. Such a condenser will withstand potential difference which will give an inch discharge through air, and will show no brush discharge or glow in the dark. A still better condenser may be made of micanite sheets, each about one-thirty-second of an inch thick. The condenser made of this material should be stacked up and then placed in an oven till the micanite is softened and then be placed in a letter press and compressed while cooling. The only drawback to micanite is its expense. If it is intended to have the condenser in the same box with the high-frequency coil, which necessarily contains oil, no other insulation than the glass and oil is needed. Dry condensers like the above are, however, very convenient where the parts of the apparatus are in separate boxes, the box containing the high-frequency coil alone requiring oil.

The high-frequency transformer may be made in a great variety of ways. From theoretical considerations and after much experimenting I have arrived at the form shown in Fig. 15 as at the same time the most efficient and the easiest to construct. It can be shown that the potential obtainable at the terminals of the secondary or the length of discharge is practically independent of the number of turns in the primary coil, provided it has one turn and the total resistance (ohmic) of the primary coil is kept constant. The length

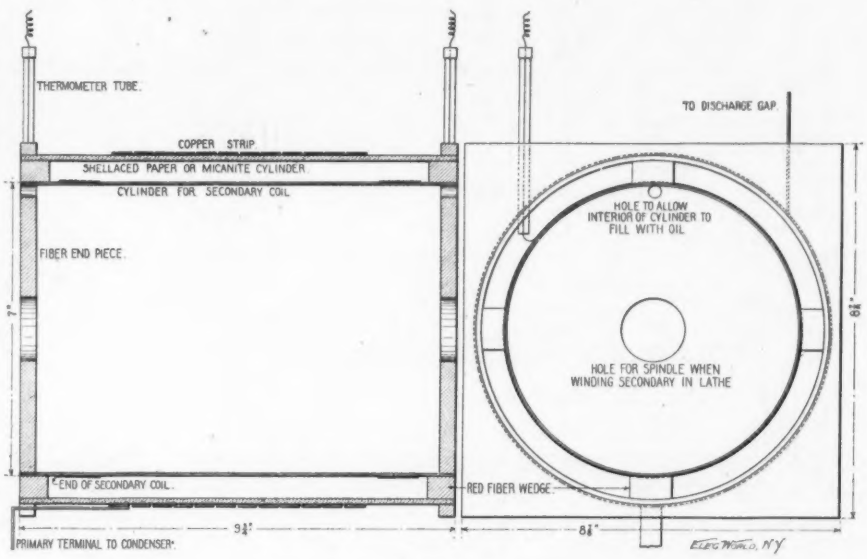

FIG. 15.

of discharge is proportional among other things to the number of turns per unit of length of the secondary coil, the length of this coil, and to its diameter. Experience shows that the secondary coil cannot be wound upon a solid cylinder of wood without greatly cutting down the spark length. In Fig. 15 the secondary coil is shown wound upon a cylinder made of thoroughly shellacked paper, or better still, upon a cylinder of micanite. No. 34 or 32 double silk covered, or even single silk covered copper wire is used for the secondary and is wound upon the cylinder sixty-four turns to the inch by means of a screw cutting lathe. After the wire is wound smoothly upon the cylinder it is covered with a thick coating of shellac poured over it. It is also well, while winding the wire on the cylinder, to have it run through shellac. Care must be exercised not to have any of the turns overlap each other. The primary is wound upon a larger cylinder, as shown in the diagram. The most advantageous material to employ is insulated copper strip such as is used in winding some kinds of dynamos. Strip about three-eighths of an inch wide and three sixty-fourths of an inch thick, triple cotton covered, is what I have used to advantage.

Since, however, most of the resistance of the circuit is encountered at the discharge gap most any kind of coper wire will answer for the primary. The turns should come nearly together and the completed coil should have about two-thirds the length of the secondary coil. The inside cylinder upon which the secondary is wound has a disc of hard wood or red fibre fitted into each end, and the ends of the outside cylinder fit into circular holes cut in square pieces of fibre, as shown in the diagram. The cylinder for the secondary is held centrally in the outside cylinder by fibre wedges so that it can be removed if required. The secondary terminals are brought up through thermometer tubing, as shown in the figure. It is almost needless to remark that no nails or metal should be used in the construction of this part of the apparatus. When the high-frequency transformer is placed in a box and covered with a good quality of engine oil a continuous 9-inch discharge may pass between the terminals without any danger of breakdown. If, however, any solid wax compound is used as an insulator, though it may hold up for a time, sooner or later the discharge will eat its way through the insulation and cause a breakdown. Unless the apparatus is made on an excessively large scale for the length of discharge to be obtained it is my belief that oil is the only insulator that can be *permanently* depended upon. Paraffin does not dissolve in engine oil and a box can be made oil tight by pouring into it boiling hot paraffin until the pores and cracks of the wood are well filled. If one is constructing a high-frequency apparatus for experimental purposes it is well to put the different parts of the apparatus in separate boxes. Only the box containing the high-frequency transformer need be filled with oil. If, however, it is desired to have all the parts of the apparatus in one box complete the best

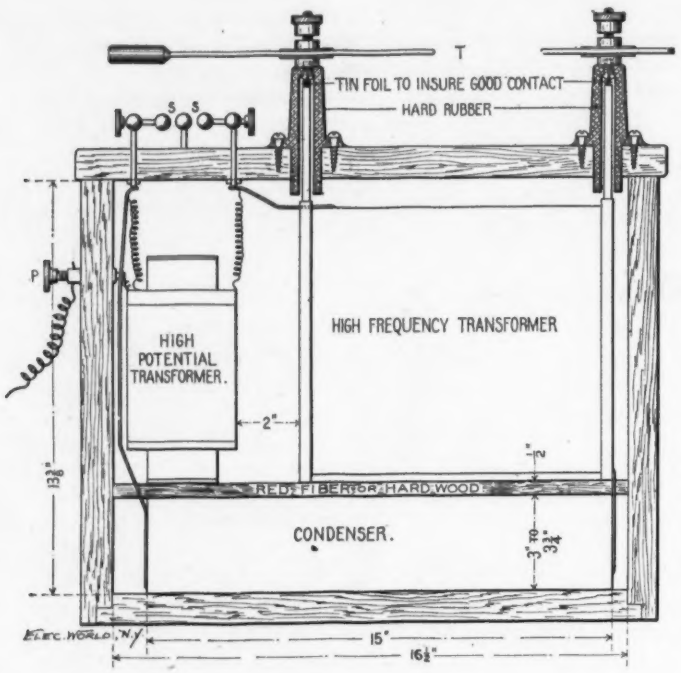

Fig. 16.

relative positions for the different parts of the apparatus and the necessary size of box to use so as to get the required insulation is shown in Fig. 16. The discharge across the gap *s s* is very noisy and it is an advantage to enclose this gap in a small box. This will greatly deaden the noise. The box must not be too small or it will get very hot from the heat generated at the discharge gap.

The large box may be filled to a level with the top of the condenser with melted resin and then filled the rest of the way with engine oil. The cover can be fitted on the top of the box, so as to be oil tight by laying a strip of asbestos soaked in paraffin on the top edge of the box and screwing the cover down tight while the asbestos strip is still hot. A vent hole must be left in the top of the box. When the terminal farthest from the transformer is connected to earth there is a great tendency for a discharge to take place to the iron of the transformer and to the binding post *p*. It is this which necessitates the separation of 2 inches between the high potential and the high-frequency transformer.

A Mechanical Computator of Fall of Potential.

BY WM. HAND BROWNE, JR.

The following simple mechanical device for the solution of wiring problems gives graphically the relation of any two elements, such as drop and resistance, when any two other elements, such as load and cross section, are known.

It is particularly convenient in calculations of conductor systems supplying current to movable receivers, or where the current demanded by fixed receivers may vary in a number of ways.

The essentials of the device consist of a string with one end fixed, and the other weighted and drawn over a pulley movable in a vertical plane. Between pulley and fixed end a system of weights is attachable at different points. The vertical tension on end pulley is also arranged to be measured, and horizontal and vertical distances along the string are shown by section paper attached to a vertical board against which the string moves. The principles of the device are simple, as the following will show:

Consider the fall of potential V, along a cylindrical conductor carrying a continuous current, C. From Ohm's law

(1) $$V = K\,L\,C/A$$

where L = length of conductor, A = cross section of conductor, K = a constant, the specific resistance.

Referring to Fig. 1, let $A\,H$ be a cord fixed at A and having a constant horizontal force T applied at H, keeping the cord in tension. Hang a weight W on the cord at any point F. This will produce a deflection of the cord. Lower the end H to G, making the section $B\,G$ again horizontal, the tension along it remaining constant. Since W is supported by the cord, it is equal to the vectorial resultant of T and the tension along $A\,B$.

Construct the parallelogram of forces about B, then $B\,E = W$ and $B\,C = T$. Let l = horizontal distance of F from A, d = deflection of cord at B from F. Then from similar triangles, since the direction of the forces W and T are at right angles, we have

$$B\,E/B\,C = W/T = d/l$$

and

(2) $$d = W\,l/T.$$

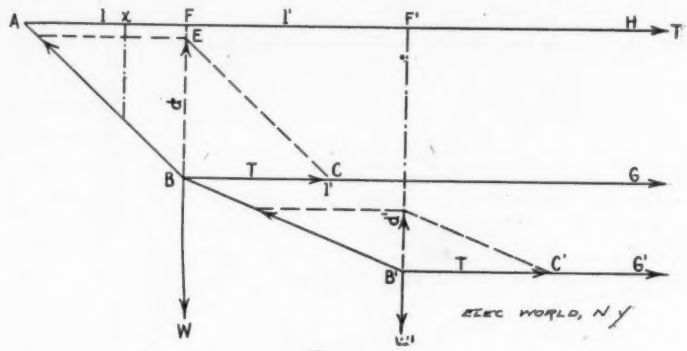

Fig. 1.

Comparing this with equation (1) and remembering that K is a constant, we see that this model can be used to show the fall of potential along the conductor if we let l represent the distance of the load from the source of supply, T the cross section of the wire, W the current, and d the fall in potential. We may then write

$$V = W\,l\,K_1/T$$

where K is a constant, depending on the units adopted for W, l, T and d. By proper selection we can make this unity and write

$$V = W\,l/T$$

and the model becomes direct reading.

And further, from similar triangles, the deflection of the cord at any point x will also be equal to the fall in potential to this point, and the model therefore represents graphically the fatal in potential along a cylindrical conductor $A\,H$, with one load W at F, a distance l from A, the source of supply.

Suppose now the cord have a second weight W' hung on it at F', Fig. 1. Adjusting the last section as before until horizontal, we will have the condition represented by $A\,B\,B'\,G'$. The tension as before is kept constant and equal to T.

Consider first that part of the cord $B\,B'\,G'$. Evidently this may be treated as if fixed at B, with one weight at B', and we write at once

$$V' = d' = W'\,l'/T$$

where d' is the deflection of the cord at B' below the horizontal

line $B\,G$, and l' is the horizontal distance from B to B' and is equal to $F\,F'$.

Passing now to the point B, we have here a weight acting vertically and a tension along $B\,B'$, which is the resultant of W' and T. We can resolve this tension into its components at B'. This would give us a weight equal to $W + W'$ at B and a horizontal force equal to T, and from what has already been shown, we write

$$V = d = (W + W')\ l/T.$$

We have then, this condition; the deflection of the cord at F is directly proportional to the sum of the two weights and the distance l, and inversely proportional to the tension T.

The additional deflection, passing from F to F_1, is directly proportional to the weight W' and the distance l', and inversely proportional to the tension T. The position taken by the cord will therefore represent graphically the fall of potential along the conductor due to the two loads. Obviously the same will be true for three or more loads. The deflection at F_1, the position of the first load, will be

$$d_1 = (W_1 + W_2 + W_3 + \ldots\ldots W_n)\ l_1 / T$$

and at F_x, the total deflection

$$d_x = (W_1 + W_2 + W_3 + \ldots W_n)\ l_1 / T + (W_2 + W_3 + W_4 + \ldots W_n)\ l_2 / T + (W_x + W_{x+1} + \ldots\ldots W_n)\ l_x / T.$$

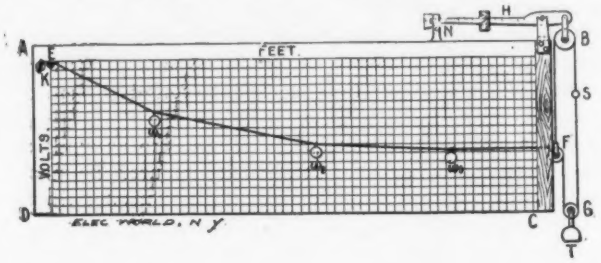

FIG. .

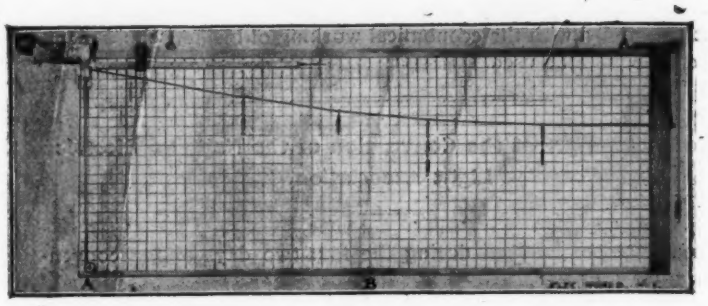

FIG. 3.

If the load be uniformly distributed, the increased deflection $d\,y$ in passing a distance $d\,x$ along the cord, is proportional to this distance $d\,x$, to the load to the right of x, and inversely as the tension T. This load is

$$W\ (l - x)/l$$

where W = total load, and l = length of cord. Then

$$d\,y = W\ (l - x)\ d\,x/T.$$

Integrating we get

$$y = W\ [2\ (l\ x) - x^2]/2\ (l\ T)$$

the equation of a parabola, which we know is the fall of potential curve along a cylindrical conductor carrying a uniformly distributed load.

The details of the construction of the models may be seen in Fig. 2. $A\ B\ C\ D$ is a drawing board, suspended vertically, and having suitable cross section paper stretched upon it. At E one end of a fine cord or wire is fastened. The other end of this passes over the movable pulley F, down around the pulley G, which carries a weight T, then upward over the fixed pulley B, after which it passes down and is attached to a hanger on F. The small weight S balances the weight of F. The horizontal tension on the cord is then $T/2$. The pulley F has rollers attached which pass up and down guides fastened to the end of the board, to make the last section of cord horizontal. The weights W_1, W_2, W_3 represent, in the units chosen, the current in amperes taken off at these points. T represents the cross section in circular mils, vertical divisions are volts lost, and horizontal divisions distances in feet.

A model of this description was constructed i[n] the electrical engineering laboratory of the University of N[e]braska in April, '97. The board is 60 inches long and 24 inches wide. The paper is divided into inches and tenths, both vertically and horizontally. A weight of 10 grams was selected to represent one ampere. A No. 10 B & S. copper wire is then represented by 990 grams, including the weight of the pulley G, and other sizes in proportion. The horizontal scale is 10 feet to the division, single distance, and vertical division one volt each. Of course the numerical value of these may be changed at will, provided the ratio be kept constant. It is desirable to use fairly heavy w[ei]ghts, to reduce the slight error which would otherwise be bro[ug]ht in by the catenary of the cord. This could be avoided by pl[ac]ing the board horizontally, but the vertical position is more co[n]venient, and the error introduced need be but a small fraction of a division. The pulleys should be light and as frictionless as po[s]sible, and the cord light and strong.

Later the model was improved by adding a scale beam, as shown at H. The weights of F, B and S are first balanced and the slider adjusted to weigh t[he] tension on the cord directly in circular mils. This can be vari[ed] at will by pouring shot on the scale pan T. The cord shoul[d] be carried over a pin at E, and then around a small drum K. This allows horizontal adjustment of all the weights at once. N i[s] a clamp to hold scale beam. It also carries a short scale to sh[ow] when the weight on cord is just balanced by the slider.

The m[e]thod of procedure is as follows: Given cross section of wire, lo[a]ds and distances, determine drop in potential. Adjust slider to giv[e] the desired cross section and pour shot on the scale pan until this is just balanced. Now add W_3, the load furthest to the rig[h]t, at its proper distance from A.

As the cord deflects, lower F to bring the last section horizontal. This can be done very exactly by comparing it with the lines on the paper. The weight W_3 will now have moved a little to the left. A slight movement of the drum brings it back into place. Add the second weight, adjust cord as before, and then add the third. The final movement of K brings all the weights into the correct position and the drop in potential to any point is read off at once.

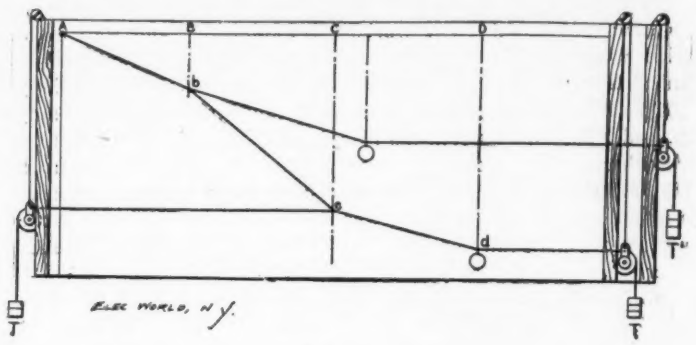

FIG. 4.

To find the required cross section to give a certain drop with known loads, clamp scale beam, set F at required drop, add the weights, pour shot on pan until last section of cord is held horizontal, release clamp and weigh. Other calculations can be made as desired, such as to find loads, given cross section and drop, etc.

Fig. 3 is from a photograph of latest model. It will be noticed that scale beam is placed at the other end of board. The cord is carried over a small pulley attached to the scale beam vertically under the knife edge. This cannot be seen in the figure. The cord then passes vertically down, around a pulley at A, and is wound upon the drum B placed near the centre of the board that it may be easily reached. The horizontal tension on the cord is produced by the weight of the slider itself, the drum being turned until the pointer on the end of the scale beam comes back to zero. With this arrangement it is necessary to have weights to represent the loads only. The right end of the cord is attached, as before, to the rollers running on guides, and it is desirable to counterbalance this by the small weight shown, so that the rollers will stay where placed. This model was found to be much superior to either of the other two in that it does away with the somewhat troublesome friction in the pulleys and with the weights necessary to give the tension on the cord. It is easily and quickly adjusted and gives readings with less than 1 per cent. of error, which is less than that usually made in our assumptions of load and distance.

Since the horizontal tension on the cord at any point represents the cross section of the wire, by varying this we can represent a change in the cross section of the wire at that point. For instance, in Fig. 4 the cross section of the line *A B C D*, from *C* to *D*, is *T*; from *B* to *C*, is $T - T'$; and from *A* to *B*, is $T + T'' - T'$, showing a decrease at *B* and an increase at *C*. Then the two cords separating at *b* can be treated independently, thus showing a divided circuit. The figure shows one load on each circuit. It would be simpler, however, to make separate calculations for each section of the wire on a model like Fig. 3, rather than to construct the more complicated one just discussed.

The Relative Importance of Central Station Losses.*

A few sentences on the above subject are to be found among the editorials of The Electrical World of New York, dated January 29. They point out in a brief and lucid manner what often escapes attention, namely, the relative importance of loss at the lamp terminals, for intance, as compared to the loss in the boiler room.

Bad firing or loss of heat by the chimney simply represents a waste of fireman's wages and coal. Then are traced the losses due to condensation in steam pipes and cylinders, which involve in addition to these increased boiler capacity to supply them; in turn, the losses in dynamos, mains, fittings, etc., are followed, each involving a corresponding increase of plant, until the lamps are arrived at.

It is not only astonishing but positively alarming, when one fully realizes that the loss in efficiency in the lamps requires a proportional increase in boilers, engines, generators, mains, transformers, feeders, as well as wages for attendance, and also augments the losses in every part of the system where increased load means increased loss. Our contemporary's remarks end here, but we think they could have been carried much farther. In addition to all the above we have to provide increased capital expenditure in plant, buildings and mains, increased rates, rents and taxes, increased depreciation, repairs, reserve and maintenance.

The gentlemen who spend their time in securing every customer in every town where electricity works are established, and who often flourish certain letters on their cards which should guarantee their technical abilities, would do well to remember these facts. They should be most useful to the seller of a really good high efficiency lamp, and it would be worth his trouble to demonstrate to the engineer in charge of the electricity works in the towns he visits the truth of his assertions. We have generally understood from the gentlemen referred to that their lamps were of the highest efficiency in the market and a halfpenny cheaper than any other, and the halfpenny cheaper often sells the lamp.

It would afford an instructive evening's entertainment to many central station engineers to quietly think over what it means to them; the better and more efficient the lamps connected to his system the greater number he can supply with a given plant.

When he recollects how many tight squeezes he has had to "get over the peak," he will, perhaps, appreciate what it would have done for him had all his lamps been of the highest efficiency.

The generation and distribution of electricity has been reduced to a science, and it is unfortunate, in one sense, that the suppliers of electricity have no control of that part of their system most remote from the generating mediums, where losses tell most heavily in proportion, namely, in the consumers' lamps. It follows that two towns similarly situated as to coal, water, and class of consumer, with plants identical, may from the fact that bad and inefficient lamps are used in one case and high efficiency lamps are used in the other show totally different results, and the true reason never be suspected. Little continuous wastes mount up to large sums when added up at the end of a year. We have known cases where the stopping of several small leakages at joints in the steam pipes has resulted in an appreciable lowering of the coal consumption; while the covering of the front of a boiler with non-conducting material and the stoppage of leaky glands have had the same effect.

True, these gains were small, but they were continuous and in time told up. Although the loss due to inefficiency in an incandescent lamp is small, yet it is taking place all the time the lamp is burning, and the number of lamps connected to the system being necessarily large, these infinitesimal losses soon mount up to a respectable amount and begin to make themselves felt.

*Reprinted from the London "Electrical Review."

The losses in every step of the transformation process, from the latent chemical energy of the fuel to the light emitted from the lamps, have been well thought out and means taken to reduce them as much as possible; there are losses, however, which come under other heads, and the rectifying of which does not come under the control of the engineering staff or we think they would be soon non-existent.

We refer to an item which might well come under the heading of wastes, for it no doubt influences, perhaps unconsciously, the efficiency of the whole system. We refer to the frequent changes taking plac in the engineering staff. The man who puts coal on the fires, and the man who oils the bearings are well paid for their labors; the policy being to get the best skilled labor in these departments, and to make the men contented with their posts and thereby provide against their leaving.

Look a little higher up, and what do we find? Men who have spent years, and perhaps much money, to gain the experience necessary to enable them to fulfil the many and varied duties called for, and on whom the responsibility of the working and management of a most expensive plant, in many cases running into six figures, receiving wages, for we can scarcely call it salary, about equal to a foreman in a foundry, or a shopwalker in a draper's shop. We repudiate the idea that insufficient remuneration affects the performance of duty, yet we cannot help thinking the many changes we see week by week of engineers leaving one town to go to another when a slight increase of salary is attached, cannot but have a detrimental effect on the economy of the system. In many cases we see men drifting right away into other channels where their experience commands more remnueration.

It surely holds good that if a skilled workman is to be made contented with his job and his services permanently secured he must be suitably paid. The engineers should have a like consideration extended to them, and until this is done we feel sure that there will always be present a waste which has only one cure.

The man who has to give up social life, practically, if he does his duty, and devotes the whole of his time and attention to the duties of his office, cannot possibly do it complete justice if his mind is constantly occupied with the economical working of his household plant, if the term may be used.

The Programme of the Convention of the National Electric Light Association.

The papers to be read during the first two days of the convention are as follows:

"Cost of the Generation and Distribution of a Unit of Electricity," by Calvin W. Rice, Brooklyn, New York.

"General Distribution from Central Stations by Alternating Currents," by Herbert A. Wagner, St. Louis, Mo.

"General Distribution from Central Stations by Direct Currents," by Louis A. Ferguson, Chicago, Ill.

"Public Lighting with Relation to Public Ownership or Control," by Alexander Dow, Detroit, Mich.

"Transformer Economy," by W. E. Goldsborough, Professor of Electrical Engineering, Purdue University, Lafayette, Ind.

The following is the list of topics for discussion:

"Legislative Policy as to Public Service Corporations."

"Prices and Discounts for Electric Current, and Methods of Charging Customers."

"Standardizing Apparatus for Central Station Use."

"Standardizing Specifications for Incandescent Lamps."

"Freight Rates on Electrical Apparatus."

A lecture on "Electricity Direct from Coal" will be delivered by Joseph Wetzler.

The Trunk Line Association, Central Traffic Association, New England Passenger Association, Southern Passenger Association and the Western Passenger Association have granted a rate of a fare and one-third, on the certificate plan, from all points in their territory to Chicago and return, for delegates attending the twenty-first convention of the National Electric Light Association, to be held June 7, 8 and 9. The convention hall and headquarters will be at the Auditorium Hotel, where the rates are $3.50 to $5 per day on the American plan, and $2 to $4 per day for each person on the European plan.

An Electric Torpedo Boat.

BY A NOVICE.

In an editorial in a recent number of THE ELECTRICAL WORLD attention was called to the possibility of using some form of primary battery to furnish the motive power for submarine torpedo boats. It is the purpose of this article to give a few rough figures to show the possibility of their application to torpedo boats of the regular type and to detail a few of the many advantages that would result from the displacement of the steam engine by a primary battery for this variety of vessel. It seems at first like a return to the limbo of forgotten things to advocate the use of primary batteries for the generation of great powers, but in a service where cost does not need to be considered and where silence and secrecy of movement are the first essentials, the battery possesses advantages that are so great as to outweigh its detrimental qualities of great cost and "wetness" —though the latter difficulty may be partially overcome.

A torpedo boat is a small craft having high speed, and no means of defense except its small size and ability to run away. Its offensive armament consists of a few torpedoes, adapted to be projected from launching tubes, and possibly a small rapid-fire gun to keep away other torpedo boats, etc. Its method of attack is to rush upon its enemy in the dark, and avoiding discovery, to come within close range and discharge its torpedo. If it is discovered it is considered that its chance of escape is small, since the light hull required by the necessities of the furious speeds used is unable to turn even musket bullets. Secrecy, which means silence of operation and absence of lights or fire of any kind, is necessary therefore, and if these conditions are fulfilled speed is not of such great importance. In a torpedo boat attack in the recent war between Japan and China, the whereabouts of the attacking boats were betrayed by the flaming of their smoke-stacks under the forced draught used to bring them up to speed. This danger would be entirely obviated by the use of electric propulsion, and the noise of a high speed engine, especially one of delicate construction and liable to have a "knock" in it would also be supppressed. Beside these advantages, the electric machinery being smaller, at least in its vertical dimension, does not require the boat to have so high a freeboard, and the elimination of the smoke-stack leaves a much smaller target for hostile fire.

The question, however, is whether or not enough battery can be floated in a torpedo boat to give it the necessary speed and manœuvering qualities. Take as an example the 140-foot boat, having 14 feet beam and somewhat less than 6 feet draught, and a displacement of 110 tons. Such a boat equipped with engines of 2000-i. h. p. can make a speed of 25 knots, which is enough for all torpedo boat purposes. In such a boat the weights are distributed somewhat as follows: Hull and fittings, 20 tons; armament and crew, 10 tons; coal, 10 tons; shafts and screws, 5 tons; and engines, boilers, condensers, stacks, etc., 65 tons. The weights of the motive power equipment, not including the screws and the coal, a total of 75 tons, is the maximum that can be given to the proposed electrical equipment.

Assume now that the boat is of the twin screw type, each shaft carrying the armatures of two 500-hp motors working at 500 r. p. m. The four motors will weigh about 12 tons, this figure assuming that every pound of unnecessary weight is eliminated, the fields made of laminated iron, etc. Subtracting this from the 75 tons which can be allowed for the electrical equipment we have 63 tons left for battery conductors and controller. Of this 60 tons can be devoted to the battery.

Of the many well-known varieties of primary battery none seem better fitted for this class of work than the element using plates of zinc and black oxide of copper in a strong solution of a caustic alkali. While its E. M. F. is comparatively low its current output is steady and large and its internal resistance very low. For purposes of computation assume that the cells consist of twenty-five plates, thirteen of zinc, each 18 inches square x 3-16 inch thick, and twelve plates made of the copper oxide compressed on a surface of copper, each plate being 18 inches square and one-half inch thick. This element can be assembled in a glass jar 19 inches cube, having a cover which, as the battery gives no fumes, may be fastened on watertight so that there will be no splashing of the contents in a seaway. Such a cell would contain about 336 pounds of plates and about 160 pounds of electrolyte solution, assuming the latter to have a specific gravity of 1.4, and would weigh complete, including the glass jar, 580 pounds. Allowing 600 pounds for each cell, it is seen that in the weight limit 200 cells may be carried. There is ample room in the boat for the cells, so the question of space does not enter. They may all be installed well below the normal water line. Each of these cells gives about 0.8 volts E. M. F., and at a discharge rate of 1.5 amperes per square inch of active plate has an energy output of 9720 watts. Hence 200 of them will give 1944 kilowatts or, assuming that the efficiency of the motors and circuits is 75 per cent., will give 1944 mechanical horse-power at the screws. This is sufficient for a speed of 25 knots.

Taking the figures as given it is not difficult to show that for a rise in temperature of the battery not inconsistent with its running successfully the resistance between the plates would have to be of the order of 0.05 ohm per square inch of electrolyte. This is certainly not possible in present practice, but there is no ground upon which it can be said that batteries cannot be made to fulfill the difficult requirements of such a service as the article indicates. As against the advantages that are enumerated may be placed the limited range of service of such a boat, its high cost and the difficulty of replacing the batteries. These causes, allowing that the boat could be made to work, would limit its radius of action to the immediate vicinity of the supply station and make it ineffective save for harbor defense. Still the subject is one upon which it does no harm to speculate, while the advantages enumerated, if they can be realized, are sufficiently great to make the serious study of the problem of high speed electric boats well worth while.

By grouping the four motors in the usual series parallel combinations the draught upon the battery would be far below this maximum rate of working at cruising speeds, since such a boat only requires about 200 kilowatts for its propulsion at 9 or 10 knots. Batteries of the type mentioned are to some degree reversible, and in port the boat might be charged by connecting its batteries to an appropriate dynamo. The convenient size of the cells permits them to be easily hoisted out and replaced with fresh ones.

Such a craft as has been described is essentially a harbor boat, not being of sufficient size for service in rough water. If it is assumed that the batteries can stand the current draught indicated it is readily seen that it has advantages over the steam driven type of the most important order. Working in silence and without the danger of flaming funnels it can creep upon its prey with more certainty, and the absence of smoke pipes, smoke, and the noise of lightly built engines forced to their utmost would make it a target of extreme difficulty even if discovered. A few shots through its upper works would cut no steam pipes and wreck no flying engine or high-pressure boiler. A broken cell could be bridged over in a minute or less, and even with half of the cells crippled the boat could make its retreat. The motors are not liable to injury by small shot, and even with three of them disabled the boat could make fair speed. The most important advantage, though, next to the secrecy of its movements, would be the fact that the commanding officer would be able to drive the boat ahead or astern at the speed he desired by a movement of one hand upon the controller. Response to this would be instantaneous and the chance of error in signals to another man would disappear. The ease of manœuvering such a boat would be greater than that of any kind of steam driven craft whatever.

Of course there are many questions to answer before the serious design of such a type of boat is undertaken, the most important being whether such a battery would work as here described. It probably would not, but it is likely that some form may be made that will. Long cruising radius is entirely unnecessary in such a boat, as one hour's run at full speed would carry it nearly 30 miles, a distance beyond which there will rarely be occasion to send a harbor boat. If the battery can hold out for an hour at full speed it can probably work the boat for a run of over 100 miles at cruising speed of ten knots. Indeed a gasoline engine might be carried, by slightly diminishing the weight of the battery, that would serve for ordinary movements of the boat, leaving its store of electric power ready for instant use in emergency. The electric boat does not have to "get up steam" or fan its fires at the approach of a conflict. A turn of the handle and it is at full speed.

"The stripped hull slinking through the gloom
Half guessed and gone again—"

A New Insulator for Condensers.

According to the specifications of a patent recently issued to Mr. Charles S. Bradley, pure stearate of lead has a specific inductive capacity seventy-five times as great as that of air, and offers a great resistance to electrical puncturing.

Is There Any Such Thing as "Cooling Effect"?

To the Editor of The Electrical World:

Sir:—Mr. H. E. Raymond, in his comments on "cooling effect" in your issue of May 7, seems to have confused two entirely different things, namely, so-called "cooling effect" or the instantaneous cooling out of an arc due to heat conduction through the electrodes, and the relatively high temperature of electrodes which in some special cases is necessary to start an arc.

There is no question but that hot electrodes will maintain an arc which cooler electrodes would not. Also, as Mr. Raymond points out in his second paragraph, it will be found that under certain conditions if arc suppression is to be repeated at frequent intervals large electrodes will fail to strike the arc for some time after smaller ones may have begun. But this has nothing whatever to do with the "cooling effect."

The phenomenon to which Mr. Raymond calls attention is one in which the conditions are such that an arc could not possibly form with either large or small electrodes until these had first been raised to a certain temperature. Take, for example, Mr. Raymond's own illustration with the arc lamp. The blunt carbons do not cool out the arc; the electrical conditions are such that an arc cannot be started even with small carbons until the temperature of the carbon tips has been raised sufficiently to bridge the gap with conducting vapors. The formation of the arc is absolutely dependent on this high temperature of the carbon tips, and with a constant current it is obvious that large blunt carbons will take longer to reach such a temperature than smaller carbons with tapering ends.

The starting and maintenance of an arc may depend upon the temperature of the electrodes, but the arc being once started it is not in the nature of any material with which we are familiar to conduct heat away rapidly enough to cool out that arc.

Pittsburg, Pa. Alex. Jay Wurts.

Is There Any Such Thing as "Cooling Effect"?

To the Editor of The Electrical World:

Sir:—The difference between the opinions held by Mr. A. J. Wurts and myself as to the existence of a "cooling effect" seem to be merely in regard to the application of the term, and I certainly do not wish to use valuable time and space in a quibble on words. Mr. Wurts seems to agree that a large mass of metal will act as a cooling device longer than a smaller one, when used as means of arc prevention. He also maintains that mass, however, will not affect the value if the arc has once become established and the metal heated sufficiently to maintain that arc at all. I agree entirely with this, as my last letter shows. Paragraph 3 says: "If the current should become permanently established in an arc across the gaps the 'cooling effect' would of course amount to nothing, and no one imagines that it would reduce the temperature."

The arrester in question, which is simply a convenient commercial modification of a gap with tank or other very high resistance in series, does not pretend to destroy an arc which has once become established. It does, however, so act that when a spark bridges the gaps the reversal of current (which is limited by the low resistance) in connection with the large radiating surface of the electrode *prevents* an arc from forming, regardless of the frequency of action. It does not rupture one already formed.

The resistance limits the current, and the size of the electrodes prevents a rise in temperature during any long continued action, *i. e.*, a rise sufficient to maintain an arc.

Smaller electrodes will act as well during a few discharges and across the terminals of a comparatively small machine, but will not continue effective if across those of a large generator and if the action is of long duration and great frequency of discharge. Perhaps I should say here "have not" done so. In order to make the conditions equal the same current should be employed, or rather the same resistance.

A relatively much higher resistance in series with a set of small electrodes will cause much greater similarity of action, but with as low a resistance as practical the large electrodes will prove much more effective "coolers."

Referring to the arc lamp illustration as the simplest, it seems very evident to me that the larger surfaces of the carbons in the second case act decidedly as cooling devices in preventing the formation of an arc.

Paragraph 5 of my last letter should read "prevent" for "extinguish" or "extinguish instantaneously with its formation."

Taftville, Conn. H. E. Raymond.

Motor Starters.

To the Editor of The Electrical World:

Sir:—I note in your issue of April 16 that you state as follows in regard to motor starters:

"What is ordinarily known as an automatic motor starter might better be termed a motor stopper, the name really signifying a device by which, when the current is shut off, the full resistance of the starting rheostat is inserted in the circuit. An ideal automatic motor controlling mechanism would consist of a device so arranged that when the main switch is closed on the motor the resistance arm would move gradually from resistance all in to resistance all out, at which position it would remain until the current was turned off or the motor was overloaded, in either of which cases it should again insert full resistance, and in case of overload preferably open the armature circuit. No such device is at present on the market."

I built an automatic starter, similar to the one you describe as an ideal starter, over a year ago, and the same has been regularly manufactured and on the market since that time. This starter is operated by simply closing a double pole knife switch to the main circuit, this action deflecting a strong spring which operates the rheostat contacts, cutting out the resistance at a speed determined by a pneumatic dash pot. When the circuit is open the resistance is automatically thrown into the circuit. The starter is supplied with an under voltage and an overload release, the action of either opening the double pole knife switch. The main switch cannot be closed unless the resistance is all in circuit with the motor, and when the knife switch is closed the resistance will not be cut out of circuit unless the current flows through the motor, and the knife switch would not stay closed when the hand is taken from it unless such a current existed. F. E. Herdman.

Milwaukee, Wis.

[The starter described does fulfill the requirements mentioned as some of those of an ideal motor controlling mechanism.—The Editor.]

A High-Tension Switch.

To the Editor of The Electrical World:

Sir:—I have read the communications of Mr. Charles Wirt in the issue of May 19 and of Prof. Elihu Thomson in the April 2nd issue of The Electrical World, both referring to the article on "A High Tension Switch," in the March 5th issue. You yourself stated in the issue of March 19 that the switch referred to combined the two well-known principles of multiple break and non-arcing metals with the new and very important one, namely, the succession of breaks, one of which must occur at the time when the instantaneous value of the current is zero.

I wish to call attention to the fact that there is still another principle combined in the Mueller switch, and that is the rotary motion and friction on all the contact surfaces when the circuit switch is either closed or open. This is the sine qua non of a practical instrument for this purpose. Mr. Charles Wirt showed no drawings of his switch, but I feel safe in saying that a multiple break alone is not sufficient for a high tension cut out. The drawings of Professor Thomson show ingenious ideas, but no practical switches. Referring, as does Professor Thomson, to Fig. 4 of the patent 500,629, it seems to me that the chain lever must be of an insulating material, which, if elastic, would soon be burned, and if hard would be likely to breakage. Furthermore, in all of the devices, Professor Thomson referred to the balls making and breaking the contacts always at the same points. Such a switch would soon be burned to such an extent as to make the contacts very poor. The rotary motion of the rollers is the principal claim allowed me in my United States Patent No. 595,887. H. Mueller.

Nuremberg, Germany.

Convention of the American Society of Mechanical Engineers.

The American Society of Mechanical Engineers will hold its thirty-seventh meeting at Niagara Falls, N. Y., from May 31 to June 3, 1898. The sessions will be held at the Cataract House, which will also be the headquarters of the Association. The programme of the meeting differs notably from that of the last meeting held in New York City by reason of the absence of papers on strictly electrical subjects. A paper of great interest to electrical engineers, being an illustrated description of the work and methods of the Cataract Construction Company, will be presented Tuesday

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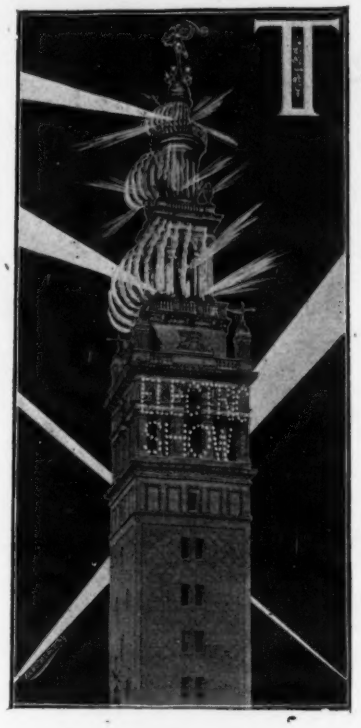
evening, May 31, by Messrs, Coleman Sellers and W. A. B ackenridge. Other papers of value to electrical engineers—by reason of their interest in steam engineering—are the following: "Plea for a Standard Method of Conducting Engine Tests," by George H. Barrus; "Extension of the Standard Uniform Methods of Conducting and Reporting Steam Engine Tests," by Bryan Donkin; "The Hanging and Setting of Fire Tube Boilers," by O. C. Woolson; "What Is the Heating Surface of a Steam Boiler?" by C. W. Baker; and "The Protection of Steam Heated Surfaces," by Charles L. Norton.

Electric Power for Unlocking Safes.

According to German newspaper dispatches to which our attention has been called by Mr. Josef Herzog, the effects of a heavy short circuit on the Berlin Electricity Works, early in April, were quite serious. Not only were the electric railways and the electric lighting system shut down, but the banking institutions which had electrical locks on their safes and vaults, were unable to open them for a considerable time. This, if true, indicates the use of electricity from the lighting circuits for manipulating the safe locks.

At the Exhibition.



THE ILLUMINATION OF THE TOWER.—A popular feature of the exhibition, intended to attract the attention of the public at night at any point in New York City from which the Madison Square Garden tower may be seen, is the brilliant illumination of the latter. This is accomplished on a new principle, the tower being draped in yard after yard of bunting. Two thousand yards of very thin imported white silk gauze, costing 50 cents per yard, is used, the material being mounted in vertical strips 1 yard wide on halyards running up the sides of the tower. There are three tiers of these strips, one above the other, the lowest one being 30 feet, the middle one 25 feet and the upper one 15 feet in height. In the lowest tier there are thirty of these vertical strips; in the middle twenty-four and in the upper eighteen, distributed around the tower. Caught in the wind these strips flutter continually, giving, when illuminated, a beautiful effect when seen from the ground hundreds of feet below. The strips stand out slat-like, parallel with each other in the wind, and lamps are arranged to illuminate these flat planes obliquely from within. The illumination is effected by fourteen stage lamps supplied by the Ziegler Electric Company, the color on the three tiers being different. Eight lamps are placed within the tower, and six more are mounted with projecting lenses on the roof 100 feet below, sending their rays up obliquely on the fluttering silk. The current is fed to the tower on the three-wire system by three No. 00 cables, the total current consumption being about 300 amperes when the big searchlight is in operation. The effect is intended to be that of a mammoth fire, but the first impression of the casual observer is that the tower has been converted into a mammoth imitation of the illuminated butterfly dances of the vaudeville stage.

THE NATIONAL CARBON COMPANY, Cleveland, Ohio, has a very complete exhibit of its varied lines of carbon products. On shelves are shown six different styles of cylinder cells, including the National No. 2, the National No. 3, the Klondike, the National Fuller, Leclanche, and other types for all classes of service. The special gas engine cell is shown. It is made in two sizes, and was designed to meet the call for batteries for hard work. It has an E. M. F. of 1 volt and low internal resistance, the No. 2 cell giving a current of 6 amperes on short circuit, and the No. 3, 20 amperes. The exhibit also includes a complete line of carbon specialties for telephones; special granular carbon for telephone work; special diaphragms; and carbon pencils from one-sixteenth to 6 inches in diameter. The smallest pencils are used for laboratory work and as resistance rods, while the largest are smelting electrodes. The exhibit is somewhat historical in character, since it shows by samples the development in the carbon line from the beginning down to the present day. The National Company makes a distinction between services in the manufacture of generator and motor brushes, a full line of which is also shown. The company is meeting with much success with its solid carbon for enclosed arc lamps, and claims to be the first domestic company to make carbons for this service, which, as is well known, is very exacting. The exhibit is in charge of Mr. M. H. Moffett, of the Cleveland office.

MESSRS. WOOD, SHAW & CO., 40 Broad Street, New York, have an exhibit on the right-hand gallery, and have a varied display of goods. At the back of the booth is hung a sample board of Imperial leaf and gauze dynamo brushes manufactured by Mr. H. M. Shaw. Another board contains a line of the Shaw universal non-arcing lightning arresters, single-pole and double-pole. These devices are enclosed in iron boxes, some of which are uncovered

THE EXHIBIT OF THE NATIONAL CARBON COMPANY.

to permit the inspection of the interior construction. These lightning arresters are designed for light and power circuits, direct and alternating, and are manufactured by the Universal Electric Company, of New York. On a third sample board is shown a full line of New England snap, indicator, flush, lock and push switches, new all-copper slow and quick-break knife switches, manufactured by the O. S. Platt Manufacturing Company, Bridgeport, Conn. A showcase at one end of the booth contains a line of Partridge motor and dynamo brushes and switches of various sizes and styles, and at the opposite end of the booth is a table containing a large number of Partridge motor and generator brushes. Two octagonal wooden poles, plain and treated, for electric light and power use, stand on the floor of the booth. These are made by A. D. French & Co. At the back of the booth is hung one of the Wood & Shaw ornamental arc lamps.

THE LE VALLEY VITAE CARBON BRUSH COMPANY, 39 and 41 Cortlandt Street, New York, shows in a booth in the gallery, samples of

THE EXHIBIT OF WOOD, SHAW & CO.

brushes of all sizes; also Gold Medal commutator compound. This compound is guaranteed to double, at least, the life of commutators and brushes when applied to commutators.

ALL THE LARGE ELECTRIC SIGNS in the exhibition equipped with metal letters and full-size lamps were installed by Mortimer Norden, of 125 West Twenty-eighth Street, New York City.

THE NEW YORK TELEPHONE COMPANY is to be commended for its public spirit in making a handsome and attractive exhibit in spite of the little need it has for advertising in the electrical field. The booth is equipped with a forty-drop branch exchange switchboard, connected by several trunks with the Eighteenth Street exchange and serving some thirty stations scattered through the exhibition. Four blue-bell public booths are also in place, showing the latest model of pay stations. In the line of special apparatus a diver's set is shown mounted in a complete diving suit, the receiver and transmitter being fastened firmly in suitable positions in the helmet. A marine set for use on shipboard in positions exposed to the weather is also shown. This is mounted on a heavy brass pedestal, the receiver, attached to a waterproof flexible cord, being arranged to fit over and close the opening of the transmitter, the pair being mounted on trunnions so that they can be turned down in such a position that water will not enter them when out of service. A mining set, also made of heavy weatherproof parts, is also shown. The exhibit is attractively set off by handsome furniture and palms, the design being that of Mr. Herbert Laws Webb, the exhibit being in charge of Mr. S. B. Brewster.

JOHN A. ROEBLING'S SONS COMPANY, Trenton, N. J., has a large booth in the gallery at the northeast corner of the Garden. This is divided into two rooms, one handsomely furnished as a reception room and the other filled with exhibits of the comprehensive line of wires and cables manufactured by the company. About 10,000 pounds of material is put on exhibition in this small room, a heavy special foundation being required for supporting it. The different steps of wire construction are shown by exhibits of material in the different stages from the ingot to the finished insulated product. Two great ingots stand at either side of the entrance. One of these is the standard 201-pound size; the other a special size of ingot made at the Calumet & Hecla Smelting Works for the Roebling Company, its weight being 361 pounds. This extra large size is used to reduce the number of joints in the rolling of trolley wires. One section of the 29-mile three-conductor armored submarine cable supplied to the Western Union Telegraph Company to run under Puget Sound is shown, an interesting feature of this exhibit being the fact that one continuous length, 20 miles long, was supplied, weighing 444,000 pounds. Another big spool of a cable made for power transmission purposes and insulated with saturated paper and lead covered is shown, the Metropolitan Street Railway Company, of New York City, having given a first order for one-half million feet of this cable with 1,000,000 circular mils cross section of conductor. Dry paper

Wires and Cables Shown by the J. A. Roebling's Sons Co.

cables for telephone service, special cables for telegraph service and gutta percha insulated jute armored cables for submarine service are also shown. In trolley wire the clover leaf and the new figure 8, with the lower lobe considerably greater than the upper, the section resembling closely the shape of the sole of a shoe, are shown, as is another section made with both lobes equal for reversing the wire when the lower lobe is worn. In the line of bonds a new modified Columbia bond is on exhibition, the modification consisting in the substitution of a short braided conductor for the long solid rod, the terminals being the same. This bond is intended for use under fish plates. The exhibit was designed and is under the charge of Mr. W. L. Doyle.

MESSRS. STANLEY & PATTERSON, New York, are well represented by a well-designed and arranged display of apparatus and supplies. They show long-distance, interior and toll-line telephones; telephone switchboards, electric bells, annunciators and clock burglar alarms. In the electric light line are exhibited switches, colored incandescent lamps, the different colors being applied by dipping the bulbs in Bohemian enamel. A line of general supplies is also shown.

THE ZIEGLER ELECTRIC COMPANY, Boston, shares a booth with Stanley & Patterson, New York City, the two together showing a most complete line of instruments, fittings and small fixtures. One of the particular features of the Ziegler Company's exhibit is the Empire stage lamp which the company manufactures. The chief feature of this lamp, the design of which has been recently improved, is the arrangement of the positive carbon in a horizontal line directed straight through the back of the regulator and aiming at the centre of light distribution. The negative carbon comes up to meet the horizontal at its forward end from below, thus giving a crater which throws all its light directly out in the desired direction. The lamp is fitted with an arc striking magnet, the armature of which has considerable play, sufficient to feed the lamp for about one-half an hour, when the carbons must be fed by hand, thus doing away with clutches and the delicate automatic mechanism which gives so much trouble in rough stage work. Fourteen of these lamps are used in the spectacular illumination of the tower described in another note. The lamps are made both for diffusing light through colored screens for stage

The Booth of Stanley & Patterson and the Ziegler Electric Company.

use or with a lens as searchlights. A new enclosed arc lamp made by the Ziegler Company, for all circuits and all commercial voltages, and a complete X-ray set, consisting of a large induction coil, condenser, tubes, etc., are shown, the latter being equipped with a valuable auxiliary, namely, a motor generator for transforming from 110 to 10 volts, the lower voltage being much more suitable for induction coil make and break mechanism than higher pressures. The Empire stage pocket is also an interesting feature of the exhibit, which contains apparatus of too great a variety for detailed description in these columns. The exhibit is in charge of Mr. Chester Snow, the treasurer of the company.

ZIMDARS & HUNT'S exhibit calls forth much favorable comment from visitors to the exhibition; it is situated on the Twenty-sixth Street side. The visitor in his tour is attracted by the glittering array of bright copper objects. Upon closer observation these are seen to be a display of the panel boards, switches, automatic motor starters, etc., made by the firm. Here is seen a most complete exhibit of panel and feeder boards, all of the very latest forms, beside the older and better known types, which are shown mounted on marble and slate in innumerable variety. In the rear of the booth all types of the Zimdars & Hunt automatic switches and motor starters are shown. Besides these there are seen several new types recently brought out, which contain features of merit. A new type of automatic starter known as Type D is shown for the first time, and so well has it been received that the firm has already received many orders for them in their various sizes. One wall of the booth is almost entirely taken up with a display of knife switches, lugs, connections, etc. All types are shown and in the various sizes. The copper-back connections which this firm has recently introduced also come in for considerable attention. The instrument switches should be examined by those not already familiar with them. These, though but recently introduced, have many points of merit. In addition to the above there are many other devices of real merit on exhibition. The booth is enclosed at the front by copper bars representing switchboard bus-bar work, a gigantic knife switch serving for a gate. As might be expected, this novel feature is not overlooked.

THE BARROWS VEHICLE COMPANY, 302-306 West Fifty-third Street, New York, has brought out a new type of electric carriage, one of which is shown in one of the exhibition illustrations. The distinguishing peculiarity of this carriage is the fact that it is a tricycle, the single forward wheel carrying attached to it all the driving and steering mechanism, the carriage body and the two rear wheels being easily separable from the front wheel at the steering head, giving an opportunity for changing the carriage body whenever this may be desirable. The controller and brake lever are mounted on the steering handle. The small carriage shown in the illustration is the lightest electric vehicle yet made, weighing but 700 pounds altogether. It is equipped with twenty cells of Willard storage battery, made by Sipe & Sigler, of Cleveland, Ohio. To prevent spilling and disintegrating the positive plate is enveloped in cellulose pulp, and the positives and negatives are separated by perforated rubber shields. The motor consists of a 1-hp Riker four-pole machine, the pinion of which drives direct a large annular gear mounted on the spokes of the driving wheel. A larger carriage, equipped with a 2-hp Eddy motor and thirty-two large cells, is also shown in the exhibit. A peculiarity of this carriage is the fact that the driving wheel is fitted with wooden spokes, the tires being solid rubber. One of the chief advantages of this style of construction is the fact that the carriage steers just as does a bicycle.

THE NATIONAL METER COMPANY, 84 Chambers Street, New York, makes an exhibit of the Nash gas engine direct-coupled to a Walker generator. The engine is a 30-hp two-cylinder vertical machine, with electric ignition, hit or

miss governor, and the customary four-cycle method of operation, giving between the cylinders one stroke per revolution at full load. The set runs at 280 to 300 revolutions, the dynamo running a few revolutions slower by reason of the slip in the big clutch coupling between the two. This coupling is fitted with a sensitive centrifugal governor controlling the clutch in such a way that if the engine exceeds its normal speed the slip is increased to make up for it, and vice versa, giving very steady running on the dynamo and close regulation of voltage. While running steadily at about half-load the voltmeter at the exhibition shows variations not greater than one-half a volt on a 110-volt circuit. The regulation is also helped by a heavy 6-foot fly wheel. The set is supplied with New York City gas. The whole set, engine, generator, etc., occupies a space of about 9 feet by 5 feet, this being remarkably small for a 300-lamp generating set, considering the fact that no boiler space is necessary. A smaller 3-hp single cylinder engine is also shown.

F. A. LA ROCHE & CO., 652 Hudson Street, New York, make a complete exhibit of switchboards, appliances and alternating-current dynamos. In the booth on the main floor they show two Tennessee marble switchboards, which are about 4x6 feet in size. On one of these there is a full line of new Ideal circuit breakers, this being a two-pole instrument with independent closing levers and triggers on each side and a solenoid in the middle. The plunger of this solenoid rests freely below it and has no pivots or attachments of any kind. When the current becomes strong enough to lift it it flies into the solenoid with increasing force and strikes a plate, throwing both triggers and releasing both sides of the breaker. If either side is closed with an overload on the line the other side gives protection, thus requiring no main switch in the same circuit. A new form of knife switch taking current through the hinge is shown, the hinge being fitted with a screw thread, so that when closed it binds the blade very tightly, but does not grip so tightly when the blade is

THE NATIONAL METER COMPANY.
THE BARROWS VEHICLE COMPANY.

ZIMDARS & HUNT.

THE SAFETY INSULATED WIRE & CABLE COMPANY.
F. A. LA ROCHE & CO.

THE SAFETY INSULATED WIRE & CABLE COMPANY, New York City, has fitted up a handsome booth in the gallery to attract popular attention, but makes no showing of its commercial products. Set in a large frame in the middle of the exhibit is a miniature imitation of battleships, buoys and mines as installed at the entrance to New York Harbor, showing the use of Safety cables for mine and buoy work. The buoys and ships are lighted with miniature lamps and move about on the water, the whole attracting no little attention. An interesting feature of the exhibit is a short section of telephone cable such as would be needed for submarine telephonic communication between New York and London with instruments of the present day. The cable consists of a copper conducting core of 32,000,000 circular mils cross section surrounded by solid insulation about 2 inches thick, armored with tool steel rods about 1½ inches in diameter, and further protected by jute cables, the aggregate diameter of the whole being about 20 inches. Prices are not quoted on this cable. A visitor may safely look into the muzzle of the 4-inch disappearing gun, in which he will see an illuminated trade mark of the company.

open. A line of enclosed arcs for either direct or alternating circuits, transformers, quick-break switches and the familiar mica and carbon alternating-current lighting arrester are also shown. A La Roche alternating-current generator of 35 kilowatts, and also one of 10 kilowatts, both 16,000 alternations, are shown, the field excitation being derived from rectifying commutators, no exciter being used. The armature of a 50-kw alternator is shown with but six slots in its surface. In the basement the Exhibition Company has a La Roche switchboard taking current from two 75-kw generators, the Edison street service and the Madison Square house plant, and distributing it to a large number of feeders.

ADAM COOK'S SONS, 313 West Street, New York, of Albany grease fame, have an exhibit in the basement of original packages of Albany grease. This well-known lubricant is put up in cans of different sizes. The Albany Lubricating Compound & Cup Company, of which Messrs. Adam Cook's Sons are the proprietors, has a showcase containing a full line of lubricating cups, and the display is an attractive one, not only to the engineer, but to the lay-

man as well. Cans of Albany electric motor grease are also shown. The different consistencies of this grease make it effectively applicable to any motor in use. It can be used in any temperature, and is said to prevent burning out of armatures, by reason of the better lubrication resulting from its use. Albany lubricating compound has been in use since 1868.

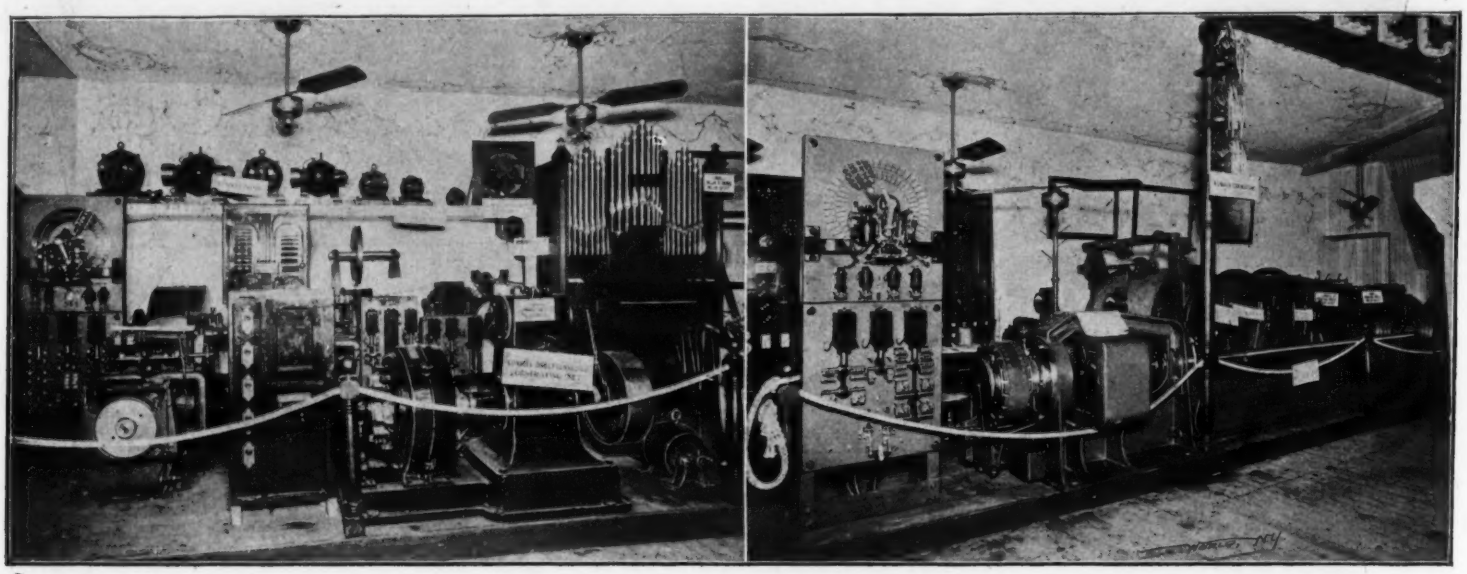
L. KATZENSTEIN & CO., 357 West Street, New York, have an exhibit under the charge of Mr. F. T. Holt. Flexible tubular packing for slip joints on main line steam pipes is shown; also the high pressure rod packing of the Fall River Line steamer "Priscilla." The different kinds of rod packing made by this firm are shown on a stuffing box. The slip joint designed by the Steam Engineering Bureau of the United States Navy Department is also shown. The flexible metallic packing consists of an inner tube of brass, triangular in shape, then wire of soft metal, and next a sheeting of brass or soft white metal, outside of this being laid a thin layer of asbestos, so as to give the packing rings a good bedding when screwed down. This packing does not harden with use.

THE SPRAGUE ELECTRIC COMPANY of New York makes an extensive exhibit, the most interesting feature of which is one of the elevator machines being built by the company for the Central London Underground Railway. Forty-nine of these machines are to be supplied by the Sprague Company, each one consisting of a tandem duplex worm gear drum hoist, with a capacity of 30,000 pounds at 100 feet per minute, or equivalent loads at other speeds. The machine is driven by two G. E. 53 motors, each direct coupled to two worms running in tight-fitting worm gears, the drum being mounted on the shaft connecting two of these worm gears. The tandem worm gears drive the drum shaft through spur gears a little larger than the worm gears. The machine is shown running as a motor generator, one side of the machine running as a motor driving through the worms, worm gears, drum shafting, worm gears and worm again the other side as a generator. Each motor shaft is fitted with a brake pulley, the two shoes of which are applied by powerful springs and released through toggle-joint control by a magnetic plunger. The two plungers are energized by a single solenoid midway between the shafts. The machine is controlled by what is called a No. 4 control mechanism, this being of the pilot motor type, similar to that used with the screw machines, but with modifications suitable for the worm machines which are over-counterweighted and drive in both directions. The other hoists exhibited by the company consist of one automatic house machine with the complete control mechanism for moving the car to any floor, either from within or without, at a mere pressure of a button, the control being such that the car cannot be moved if any door is open. The same machine is made up in smaller size for ammunition hoists, sidewalk hoists or dumb waiters, with suitable modifications of the controlling buttons, one modification being the addition at each floor of a full panel of buttons, one for each floor, with no additional complexity in the control mechanism. This arrangement allows the hoist to be sent from any floor to any other floor by a person situated at any other floor. The Sprague screw machine, type G, with 16 to 1 multiplying sheaves, built for a 150-foot lift, at a speed of 600 feet per minute, is also shown, the screw being in operation and attracting no little attention. A 5000-pound tandem worm gear drum machine is also shown. Lundell fans of all sorts, conditions and sizes, from a 36-inch exhaust fan throwing a blast down the aisle, to an organ blowing outfit, are shown, a desk fan fitted for either summer or winter use by means of a heating coil mounted like a spider web on the fan guard, being one of the most novel features. Other apparatus shown includes a Sprague wedge safety stop for elevators, a Quimby screw pump coupled to a Lundell motor, a Miehle press driven by a special Lundell multipolar motor and many other smaller devices.

MR. ELMER P. MORRIS, 15 Cortlandt Street, New York City, in his capacity as manufacturers' agent for several concerns, makes a most complete showing in one end of the gallery. Among the apparatus shown here is a full line of switches and switchboard fittings made by the Technic Electrical Works, Philadelphia; incandescent lamps made by the Warren Electric & Specialty Company, Warren, Ohio; soldering compound, bonds, commutators, lightning arresters, automatic couplings, insulating staples, railway material, Monarch insulating compound, Monarch automatic trolley wire splice, beside apparatus more particularly described in the notes given below.

A-B ARC LAMPS form a conspicuous exhibit in the space occupied by Mr. Elmer P. Morris, in the gallery. The display is under the charge of Mr. C. W. Phipps, the Eastern manager of the Adams-Bagnall Electric Company, Cleveland, Ohio, and Mr. H. C. Geiger. It consists of two 110-volt A-B enclosed arc lamps suspended from the two arms of a column support; one marine enclosed arc lamp; one 110-volt enclosed arc lamp, and two lamps in series across 220 volts, all four being suspended from as many arms on a short standard. The enclosed lamp is made for series circuits, either 5¼ or 6.8 amperes, and is also made to burn singly on 220-volt circuits or two in series on 220-volt circuits, with switches and automatic cut outs so arranged that in case one lamp goes out its place is filled by a rheostat, allowing the other lamp to burn independently. A constant potential enclosed lamp, burning one across 220 volts, is also shown. The enclosing globe of A. B. lamp differs from others in the fact that it is only open at the top both positive and negative leads coming through the cap, the lead to the lower carbon, consisting of a Stubbs steel rod to avoid corrosion where it runs past the arc. The upper edge of the globe is ground and is seated in a ground cap and forced up thereto by a german silver spring beneath the globe. Surrounding the enclosing globe and forming the top of the outer globe, which is of the ball type, is an aluminum reflector. The controlling mechanism of this lamp consists of the usual magnet with armature mounted on a hardened steel knife edge attached to a clutch bearing on a flat clutch rod. The laces of the clutch are of fibre graphite, a material particularly suited for this purpose. The same material is used for the piston of the pneumatic dash pot. The ornamental lamps are finished in oxidized copper, royal copper, yellow brass, seventeenth century brass and oxidized silver. The marine lamp is the A-B Company's standard 110-volt lamp enclosed in the usual protective casing of marine lamps. It is provided with a ring, so that it can be hung in the rigging or elsewhere on shipboard where light is needed. The lamp burns 125 hours on one trimming, and is substantial in appearance. It is used very extensively on the lake steamers, and is giving very satisfactory service. The novelty of the A-B exhibit is the enclosed series, high-tension 2000-cp lamp. The dynamos used for open-air arcs of 1200 candle-power are suitable for this type of lamp, and dynamos wound for smaller amperes, would, it is stated, possess still greater advantages. The A-B metal hanger board is also shown. This board, it is said, embraces all the points specified by the most rigid fire inspector, and conforms to all the rules laid down by the National Board of Fire Underwriters. An upward push of a pole will throw the lamp into circuit, and another upward push will throw it out again. The body of the hanger board is made of malleable iron, and the hook upon which the lamp is hung is thoroughly insulated from the rest of the board.

THE CARD ELECTRIC COMPANY, Mansfield, Ohio, has three dynamos in the exhibit of E. P. Morris. The largest of these is a 25-hp "S type" slow speed 110-volt machine. The "Type S" is that wherein the bearing at the commutator end is supported in a cup-shaped yoke, fastened to the face of the field ring. The machine is fitted with a new type of brush holder, the brushes being forced down by a large spring of flat copper coiled up spirally with the outer end extended to bear on the back end of the brush. Adjustment is made by twisting up the shaft in the middle of this spiral, the shaft being held by a ratchet and ratchet wheel. A 3-hp motor "Type E" is also shown, with a folding protecting case over the commutator. A 12½-kw 110-volt generator is also shown. These machines are run on a light ⅞-inch platform without serious vibration. One of the most interesting things in the Card exhibit is the line of safety switches and motor controllers shown. One of these consists of an automatic limit switch and rheostat, the double-pole switch being released by a trigger controlled by a magnet designed to let go on either overload or under voltage. Two spools of the bipolar magnet carry respectively coils in series with the field and the armature windings and one armature is designed to let go in case of a weak current in the shunt field, the other being designed to



THE EXHIBIT OF THE SPRAGUE ELECTRIC COMPANY.

pull up in case of excessive current in the series field. The arm of the rheostat fitted with this device flies back to full resistance, and is retained by a trigger controlled by a magnet in the field winding, so that the opening of the main switch inserts automatically the full rheostat resistance. Another controller for smaller machines is fitted with a switch and rheostat arm on one plate, the opening of the switch mechanically releasing the rheostat arm.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, Philadelphia, Pa., shows a line of instruments in the exhibit of Mr. E. P. Morris, on a switchboard made by the Technic Electric Works. The illuminated dial instruments are fitted with miniature lamps in front of the dial, under the lid, thereby avoiding shadows. They register equally well on alternating and direct current circuits, and are rendered dead beat by the use of dash pots. A direct reading arc voltmeter, the scale running up to 6500 volts, is shown, this being fitted with a ground connection, whereby with two readings the exact position of the ground on the line can be determined. Direct reading potential and current indicators are shown, as is also a portable direct and alternating-current voltmeter, ammeter and wattmeter. The portable alternating instruments do not need to be damped mechanically, and therefore are as handy as direct-current instruments.

CARD ELECTRIC COMPANY. FORT WAYNE ELECTRIC CORPORATION. AMERICAN ECONOMIZER.
THE ADAMS-BAGNALL ELECTRIC COMPANY. CROUSE-TREMAINE CARBON COMPANY AND THE FOSTORIA INCANDESCENT LAMP COMPANY.

THE FORT WAYNE ELECTRIC CORPORATION makes a comprehensive exhibit, the most striking feature being a large eighty-light, 2000-cp arc machine, direct coupled to and driven by a four-pole 110-volt motor. This machine is fitted with a new regulator, the chief feature of which is the arrangement of the friction clutches in an iron case, which is designed to protect them, yet giving an opportunity for ready inspection. Behind this machine is a marble switchboard stand, with one alternating current panel and one arc panel fitted for two machines. Of the other machines shown there are a 37½-kw, 60-cycle alternating generator, coupled to and driven by a four-pole motor, and a 5-hp synchronous 60-cycle motor. A most complete exhibit of arc lamps is shown, enclosed lamps for single working on 110-volt and 220-volt direct current, and also on 110 and 220-volt alternating circuits being included. The switchboard is equipped with Duncan meters for alternating current, integrating wattmeters showing a simple method of changing the speed by the same percentage at all loads by changing the angular position of the shunt exciting coils inside the cup, and also the method of adjusting the meter for different frequencies by changing the time constant of the shunt winding by means of an adjustable magnetic gap on an inductive coil. The new Duncan direct current meter is not shown, but one may be in place before the end of the exhibition.

AN AMERICAN ECONOMIZER capable of handling feed water for 400-hp boiler capacity is shown in running order by Broomell, Schmidt & Co., of York, Pa. Some of the details of this machine are of interest, owing to their ingenuity and fitness for the serivce intended. The tubes are all vertical, fitted with scrapers, which are kept continuously in motion up and down by a small scraping engine. The tubes are expanded into the headers both top and bottom, the joint in the top header being tapered with the larger diameter upward, so that by opening the cap over the tube, the latter may be removed and replaced without disturbing any other part of the economizer. The caps are fitted into tapered seats, the taper being in such a direction that the pressure of the water against the cap tends to tighten the joint. The scrapers are balanced on chains running over pulleys at the top of the economizer, the chains being so attached that when the scrapers are lifted their edges are forced against the pipes, cleaning them effectively.

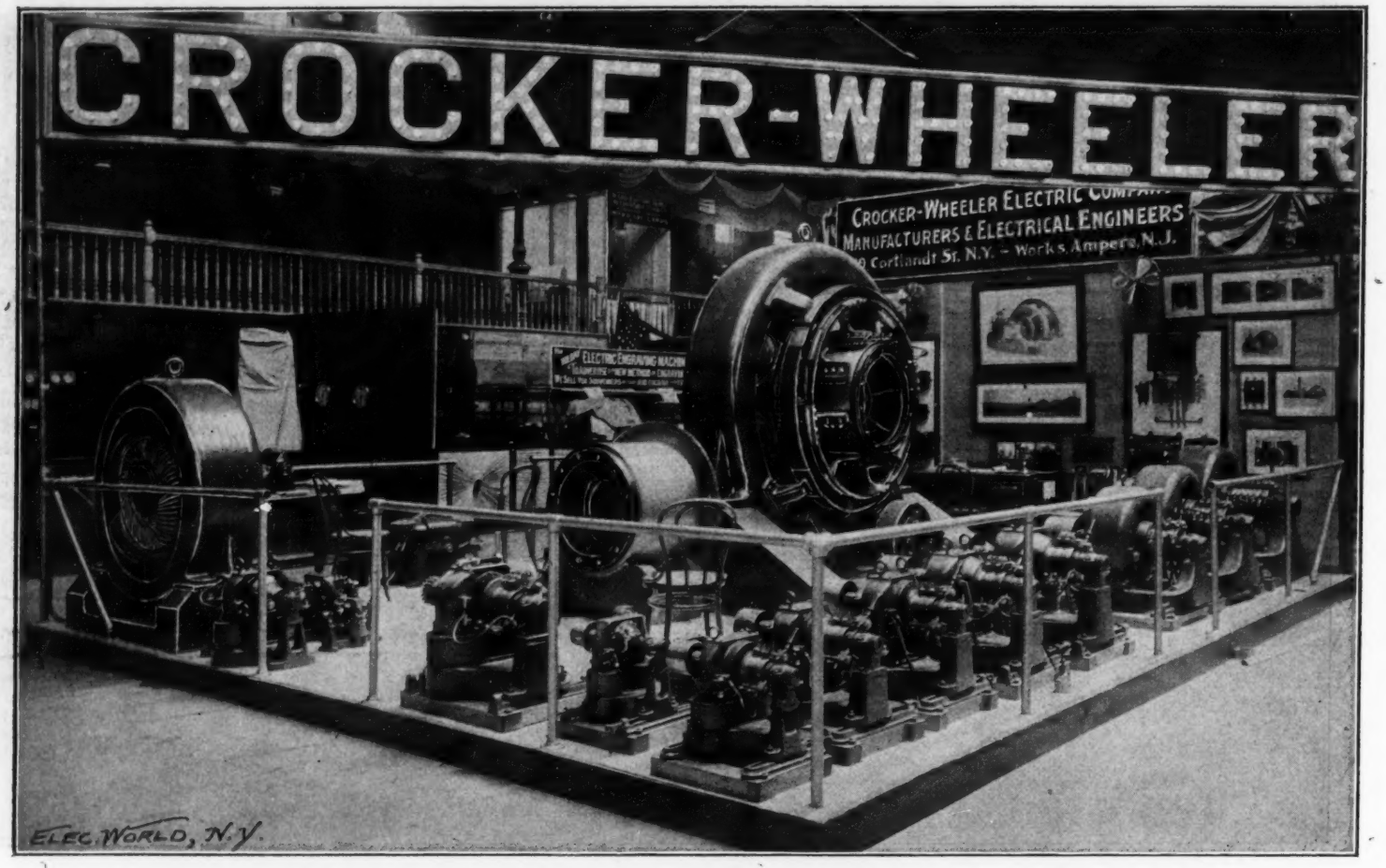
ONE OF THE ACCOMPANYING ILLUSTRATIONS gives a view of the combined exhibit of the Fostoria Incandescent Lamp Company and the Crouse-Tremaine Carbon Company, of Fostoria, Ohio. This exhibit at night is one of the most attractive in the building. One of the oddities shown by Mr. H. Stillson Hart is the display, side by side, of the smallest lamp and the largest lamp made by the company, the smaller being 3 candle power and the larger one of 400 candle power. The latter has four filaments arranged on four sides, so as to give a broad light on any side. This arrangement of the filaments, it is stated, gives a better distribution of the light. The lamp is 11 inches long and 6 inches in diameter. In the construction of the Fostoria lamps nothing but platinum and carbon enter the inside of the bulb, the paste being on the outside of the vacuum in the neck containing the leading-in wires. It is claimed that paste inside of the lamp bulb tends to produce blackening, and the fact that this objectionable feature has practically disappeared in these lamps seems to sustain the argument. The Fostoria Lamp Company is said to be the second largest lamp manufacturer in the country. With reference to the 220-volt lamps made by this company, it is interesting to note that the same guarantees are given as to efficiency, life, etc., of these lamps as are given with the 110-volt lamps. The Crouse-Tremaine Carbon Company, whose exhibit is also shown in the illustration, states that it supplies all the lighting carbons for the entire city of Philadelphia and for the entire city of New York, with the exception of two companies. The exhibit includes cored carbons for constant potential and alternating lamps. The Crouse-Tremaine Carbon Company has recently issued a reference pocket-book containing some useful tables, rules and tests for station managers and electricians, and a complete copy of the latest rules for wiring adopted by the National Board of Fire Underwriters, together with a price list and telegraphic code for all sizes of high-grade cored and solid carbons and motor brushes. The exhibits of these two companies were quite fully described in the last issue of THE ELECTRICAL WORLD.

FARIES ELECTRIC LAMP FIXTURES, in large variety, are displayed in a neatly draped booth in the gallery, by the Faries Manufacturing Company, Decatur, Ill. The Faries Universal adjustable lamp holder is movable in all directions—up and down and sidewise. These holders are shown in many forms and finishes. A line of wall brackets and portable holders is also exhibited.

THE MANHATTAN ELECTRIC STORAGE BATTERY COMPANY, 636 Broadway, New York, makes an exhibit of its Liberty electric night lamps. The case of the lamp is a miniature reproduction of the Statue of Liberty. The female figure holds overhead a 2-cp incandescent lamp, with a reflector, which is provided with a movable helmet for the purpose of throwing the rays downward on the face of the clock set in the pedestal. These outfits are finished in brass and are well made and ornamental. Each lamp is fed by a cell of storage battery set in the pedestal of the statue.

THE WARD ELECTRIC SUPPLY & CONSTRUCTION COMPANY, 39 and 41 Ann Street, New York, has an exhibit of a large searchlight; five plain and ornamental Ward arc lamps, and a display board containing samples of all the parts that are used in the construction of the lamp.

THE NONPAREIL CORK MANUFACTURING COMPANY, West Broadway and Chambers Street, New York, is showing cork sectional covering for steam heated surfaces; also for cold insulation in refrigerating plants. This substance consists of ground cork compressed at great pressure and baked at a temperature of 500°. No binding material is used other than the natural gum of the cork; this, it is said, being amply sufficient to bind the material into a dense compact mass. The cork thus treated becomes very tough and can be used for a great variety of purposes. The floor of the booth, which is in the basement of the Garden, is tiled with cork tiles. This gives a soft but firm flooring, and it is said to be very durable. The company is making third-rail insulators of this material, which are now being tested on the Hartford branch of the New York, New Haven & Hartford Railroad. These insulators are being made under the patents of Mr. W. R. Young.



THE EXHIBIT OF THE CROCKER-WHEELER ELECTRIC COMPANY.

THE EDISON MANUFACTURING COMPANY, St. James Building, New York, occupies a prominent position on the main floor at the left of the main entrance, and makes an excellent display of its varied and extensive line of manufactures. These include battery fan motors of all sizes, induction coils for X-ray work, a full line of X-ray apparatus, medical apparatus, dental apparatus, fluoroscope, etc. The Edison-Lalande battery is shown in all sizes. Against the wall at the back of the booth are tastefully arranged fans, motors, etc., and some complete medical outfits in cabinets are attracting a great deal of attention. The variety of goods shown and the excellence of finish are universally and favorably commented upon. Manager James W. Gladstone and Mr. E. M. Smiles are looking after the interests of the company.

THE CROCKER-WHEELER ELECTRIC COMPANY'S exhibit is conspicuous for the large 150-kw, 150 r. p. m., direct connected type generator standing in its centre. The parts of this machine show most beautifully some of the distinguished features of the Crocker-Wheeler design. One of these is the split hub of the armature spider, with heavy bolts to grip it tightly upon the shaft, the bolts being tightened up by wedges through their heads instead of nuts, the wedges being driven in or out by a sledge more easily than nuts can be handled in such confined spaces. The armature winding is drawn into slots with overhanging teeth, there being eight wires in a slot of this machine wound in two coils of four wires each. These groups of four wires running through the slot are each wound with a tube made of three layers of press board and two layers of Micanite cloth, a long thin strip of wood being afterward driven into the slot between the two groups of wires, wedging the whole firmly in place. The end connections are brought down toward the shaft, and where they double to run outwardly toward the next coil of the wave winding they are passed around an annular iron ring, which is thus firmly enclosed in the winding, holding it rigidly in place. The machine is also fitted with the new parallel motion brush holder, the brush being a radial carbon brush clamped into a holder, which is attached to the base by a parallel motion of four groups of spring rolled copper leaves. These are riveted into the brush holding clamp at one end and the base at the other, giving an ideal contact and perfect flexibility in a radial direction with rigidity in all other directions. Tension is applied by a helical spring and knurled nut. The field magnet cores of this machine are of steel cast into a cast-iron yoke and fitted with cast-iron shoes for increasing the area at the air gap. These shoes are split for ready removal, without taking down the machine. Immediately beside this machine is the smallest multipolar type made, which is ½ horse-power at 100 revolutions. A large line of other dynamos show the apron type of field and other features peculiar to the smaller machines. One ingenious feature is applied to a two-pole upright machine for crane hoist or similar work. One of the fields is pivoted at its base in the well-known manner hitherto used by this company for use with storage battery motor generators, but instead of making the motion of the field magnet operate a switch, it is attached to a strap brake. The motor is series wound, and whenever the current is turned on the power for magnetism of the fields draws the poles together, releasing the brake, and the instant the current is turned off the hinged field is spread by a spring, tightly gripping the strap on the brake pulley. The four-pole consequent field type for elevator and crane work is also shown, this being the type which has lately been fitted by the company with all the starting resistance wound upon the fields. By this means, the current density in the starting resistance being carried very high, the magnet is powerfully oversaturated in starting, practically doubling at ordinary loads the normal field flux, thus requiring but one-half the starting current for any given torque that would be required with a simple shunt machine, and increasing greatly the economy of current in starting owing to the increased back E. M. F. at low speeds. This machine is controlled by a Whittingham switch, the rheostat arm of which is driven by a sprocket chain from the motor shaft, the sprocket wheel being clutched magnetically and restored to a stopping position by gravity when the circuit of the magnet is opened. The Crocker-Wheeler controller is also shown in various sizes and styles, the chief modification lately made in this instrument over previous types being the addition of "pig tails" to the main contacts.

THE R. THOMAS & SONS COMPANY, East Liverpool, Ohio, makes a

most impressive exhibit of the puncture-proof qualities of its high tension porcelain insulators. The exhibitor shows first a triple petticoat "Boch glaze-filled" insulator, which he stands upside down in a basin of salt water, pours salt water into the rims and over the petticoat, and applies 60,000 volts alternating potential difference generated in a high tension Westinghouse testing transformer, between the outer basin and the pin chamber. The current at first finds a ready short circuit over the wet surface, but as this drips the static sparks follow and jump and play over the surface, and are followed at times by arcs springing over 4 to 6 inches distance. The insulator invariably stands up against this test. To show still further the abilities of the insulator the outer shell alone, without the middle or the inner petticoat, is tested in the same manner, and to still further surprise those accustomed to the weaknesses of ordinary porcelain, the outer shell in a vitrified but unglazed state is put through the same test, the porcelain even in this state being absolutely unpuncturable by any voltage that will not strike an arc clear around its surface.

H. B. COHO & CO., 30 Cortlandt Street, New York, have a whole electrical exhibition in their own space, the exhibit including pretty much all that is necessary for an insulated plant or a central station. Of its own construction this firm shows a handsome switchboard, controlling the output of the Warren alternator mentioned below; also panel boxes and panel boards, some of which are fitted with combination removable fuse holders and switches, and another of which is fitted with the firm's specialty, namely, a removable panel proper. This panel bearing the main and branch switches and bus bars is connected with all the terminals by fuses and, with the fuses out the panel proper, which does not bear the terminals, can be easily removed. Another interesting specialty is a plate glass switchboard, 3 feet by 5 feet in size, ¾ of an inch thick. The attractive appearance of this board with handsomely finished switches, bus bars, etc., can be imagined, but the board should be seen to be fully appreciated. The company also acts as selling agent for Crown Woven Wire Brush Company, Salem, Mass.; Crescent fans, made by the Marietta Manufacturing Company, Marietta, Pa.; the Diamond transformers, made by the Diamond Electric Company, Peoria, Ill., apparatus of all these makes, as well as several others mentioned below, being shown in the exhibit.

OTIS BROTHERS & CO., New York, exhibit in H. B. Coho & Co.'s space one full-size house elevator machine, with controlling mechanism so perfectly automatic in its character that no one could go wrong with the elevator if he tried. The control is such that the elevator cannot be started if any door on the shaft is open, and no door can be opened unless the elevator is at that floor. The mere pressing of a button on any floor will bring the elevator to that floor, wherever it may be, if it is not in use by somebody else, and within the car are buttons, one for each floor, the pressing of which will start the car in the proper direction and stop it at the desired level. A small machine designed for dumb waiter service with the same elaborate control is also shown, as is a dumb waiter with simply two buttons, one to send it up and the other to send it down. The complete control is effected by a series of relays, one for each floor, the pressing of any of the buttons intended to bring the car to a given floor operating the corresponding relay, which in turn closes its own circuit, so that it remains in action after the button is released, and also closes the circuit of the main solenoid controlling the main contacts of the elevator machine, the resistance being cut out gradually by an auxiliary device. The relay circuit passes through a commutating device driven by the main machine, such that when the car reaches the proper floor the relay circuit is opened, that in turn opening the circuit of the main solenoid, and that the main circuit of the machine. Immunity from danger of open doors is obtained by carrying the common return of the relay circuits through contacts on each door.

THE WARREN ELECTRIC MANUFACTURING COMPANY, Sandusky, Ohio, shows a 75-kw inductor alternating generator and exciter in the exhibit of H. B. Coho & Co. It is belt-driven by a 50-hp Eddy motor. The alternator gives 110 volts and 1100 volts simultaneously.

THE EDDY ELECTRIC MANUFACTURING COMPANY, Windsor, Conn., has several machines in the exhibit of H. B. Coho & Co. One 60-kw six-pole generator is direct-coupled to a Watertown engine, and a 15-kw Eddy generator is direct-coupled to a 22-hp Van gas engine, this engine being a vertical machine, its distinguishing peculiarity from other gas engines being the use of a Rites inertia governor, the engine giving power on every revolution, the charge being graduated to suit the load. The Eddy double-voltage plater with a commutator at each end is also shown. The machine has a capacity of 700 amperes, with 5 volts on each end.

THE AMERICAN RHEOSTAT COMPANY, Milwaukee, Wis., makes a most complete showing of its products in the exhibit of its agents, H. B. Coho & Co. The two general types of its motor starters are of sufficiently recent design to merit description. One of these is known as the automatic motor starter with overload device, and consists of a rheostat arm, to be operated by hand and an auxiliary arm mounted on the same pivot, closing the main circuit and retained by a magnet in the shunt winding. The construction is such that this latter arm can only be closed by a movement of the rheostat arm to the position with all resistance in, and when the rheostat arm is moved over to cut out the resistance it brings tension on a spring, tending to release the main circuit arm. Any interruption of the supply allows the main circuit arm to fly open, and any overload acts upon a relay, which accomplishes the same result. The main circuit cannot then be closed until the resistance is again inserted. The "Perfection" rheostat goes even further than this, being designed to prevent an ignorant or careless workman from cutting out the resistance too rapidly. The rheostat arm is not controlled by hand, but is moved to cut out the resistance by a spring which is put in tension by the closing of the main switch. The speed of the rheostat arm is controlled by a pneumatic plunger. Any interruption of the supply or overload releases the trigger on the main double pole switch, allowing it to fly open, and it cannot again be closed until the resistance is all inserted. The resistance will not cut out if the main switch is closed with the circuit open at any other point. A printing-press controller of the same make with rheostatic control of the speed, giving eleven speeds in a forward direction and three reverse speeds, is also shown. In this the quick-break reversing switches are thrown by the rheostat handle passing the standstill position. An elevator controller with similar features is also in the exhibit.

THE EXHIBIT OF H. B. COHO & CO.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering

Dynamos, Motors and Transformers.

COMMUTATION IN CONTINUOUS CURRENT DYNAMOS. Girault. "L'Ind. Elec.," April 25.—The first part of a long mathematical article, in which he discusses the phenomena of commutation in continuous current dynamos, deducing methods of calculating various factors involved. No general conclusions are drawn in the present portion.

DYNAMO BEARINGS.—Lond. "Elec. Eng.," April 29.—Several descriptions of self-oiling bearings for dynamos.

CONDENSER ACTION AND SYNCHRONOUS MOTORS.—"Amer. Elec.," May.—In a synchronous motor there are three E. M. Fs.—the impressed E. M. F., motor counter E. M. F., and E. M. F. due to the inductance of the armature; of these the counter E. M. F. can be varied within considerable limits without materially affecting the efficiency or influencing the motor with respect to load. Tthe resultant of the above three E. M. Fs., which resultant must be in phase with the current, may be made to lead the impressed E. M. F. by over exciting the field of a synchronous motor or rotary converter, such over excitation increasing the counter E. M. F. component of the resultant. The synchronous motor or rotary converter will therefore, since it has a leading current, have an action similar to a condenser. When a condenser and an inductance are in series, the E. M. F. between the terminals of the condenser may be made to exceed the E. M. F. acting on the condenser and inductance in series. In the case of a transmission line, by this means the line inductance may be overcome; or if inductance is added to the line the ohmic drop may also be overcome, or even a higher E. M. F. obtained at any point of the line than that at the generator.

THE INDUCTION MOTOR. Wiener. "Amer. Elec.," May.—A simple explanation, without mathematics, of the principles of the rotary field. A kinetoscopic arrangement is described and illustrated whereby the motion of a revolving field may be shown. This consists of a number of sheets of paper representing a two-phase or three-phase field arrangement with a dial hand showing the different directions of the resultant magnetism in each case; when the package is bent and the sheets released so as to rapidly spring back into normal position the dial hand will appear to rotate, this rotation representing that of the magnetic field.

A UNIVERSAL MOTOR AND DYNAMO.—"Amer. Elec.," May.—A description of a machine which may be used as a direct current 110-volt 1-hp motor; a direct current dynamo giving 110 volts and 8 amperes; a motor-dynamo taking 100 volts and 10.8 amperes direct current, and giving 110 volts and 6 amperes alternating current at a frequency of 60; an alternating current, self-excited generator, giving 110 volts and 6 amperes at a frequency of 60; a synchronous motor giving about ¼ horse-power at 1200 r. p. m., with single, two or three-phase alternating currents; a motor dynamo taking alternating current and giving direct current at 110 volts; a double ended dynamo giving at the same time both alternating and direct currents; as a generator, synchronous motor, motor dynamo or double ended generator, giving or taking two-phase or three-phase alternating currents. Working drawings and detailed instructions are given for the construction of the machine.

ARMATURE WINDINGS AND CONNECTIONS. Rice. "Amer. Elec.," May.—The present installment of this series describes plain and forced two-circuit windings.

Lights and Lighting.

TRAIN LIGHTING. Dick. "Elek. Zeit.," April 28.—A long, illustrated description of his system, which has been on trial on an Austrian line for the past five months. In this the accumulators are charged by a dynamo driven by the axle of one car of a train, being mounted and geared similarly to a railway motor. The claims made are absolute reliability, very good regulation, that they require very little attention, that they are cheap in first cost and cost of running. The charging is accomplished during the whole trip at short intervals of two to five minutes; every car has its battery, but there is only one dynamo to a train; the charging is done during the day, while at night the lamps are run largely from the dynamo driectly, thus diminishing the capacity of the accumulators required and increasing their efficiency. A complete diagram of the dimensions is given.

MINER'S LAMP. Richter system. "L'Elec.," April 30.—An illustrated description of this lamp run by accumulators. It develops 3 candle power for at least ten hours; it is well protected, the lamp being covered with a strong glass and a wire shield; the switch is so arranged that the circuit is broken inside of the retaining box, which is not in communication with the air, so that there is no danger of an explosion; terminals are provided on the sides of the boxes, in the form of holes in metallic blocks, so that any number of boxes may be readily connected in series with a pin coupling, for charging; the complete lamp weighs 6.6 pounds. It has been used in a number of coal mines in Germany, where it has given good satisfaction.

CLEANING ENCLOSED ARC GLOBES. Hallberg. "Elec. Rev.," May 11.—A detailed description of a proposed method. A duplicate set of globes are to be procured; twelve of these are placed in a box, together with the carbons and other necessary trimming tools, and that number of lamps are then trimmed, the soiled globes being replaced by fresh ones. The soiled ones are then cleaned at the station by washing in clean water, which will take off the fine dust, but will leave a brown-black stain around the top of the globe; the only way to clean this is to dip it into concentrated hydrofluoric acid for one to two seconds; he prefers this to using the dilute acid, as it takes much less time.

Power.

ELECTRICITY ON A MODERN WARSHIP. Shepard. "Eng. Mag.," May.—After calling attention to the very poor economy of the numerous auxiliary engines, he points out the advantages of having a single power plant and distributing the power electrically. A brief general description is outlined for a plant requiring about 1600 horse-power for the auxiliaries on board a first rate protected cruiser.

COMPRESSED AIR IN MINING. Rix. "Cassier's Mag.," May.—An article chiefly devoted to compressed air, but containing some references to electric power. He admits that compressed air can claim no particular advantage over electricity for driving a constant load, but for intermittent work, which includes about half of all the work done by motors, he claims that it has no rival for general economy or utility, particularly in mining work.

A SUN STORAGE BATTERY. Fessenden. "Amer. Elec.," May.—An arrangement for the direct utilization of the sun's rays is described, consisting of screened tanks by means of which water is led by several stages to an elevation, and is then utilized in running a water wheel and dynamo. The tanks are enclosed in glass covered houses like conservatories, and each has an adjustable screen. The heat from the rays of the sun expands the air in a tank containing water, which forces the latter into the tank above; a screen is then placed over the tank, which enables the air within to cool, when it is filled by water forced, as above described, from the next tank below. A safe estimate of the power of the sun's rays is 1,000,000 horse-power per square mile; if it is assumed that the air in the glass grouped houses may reach a temperature of 50° above the outside atmosphere, a practical efficiency of 5 per cent. may be easily reached, or 50,000 horse-power per square mile may be developed in this crude way.

PEAT BOGS.—"Eng. News," May 12.—A note on the suggestion of Frank, in Germany, concerning the utilization of the great peat bogs in Northern Germany electrically and for the manufacture of calcium carbide. He calculates that one acre of bog averaging 10 feet in thickness contains about 1000 tons of dried peat. He proposes to erect a 10,000-hp station, which would consume yearly 200,000 tons of peat.

POWER HOUSE.—"Power," May.—An illustrated description of the power plant of the Los Angeles Street Railway Company, which furnishes power for nearly all the lines in that city, as well as for commercial power and lighting circuits. Native petroleum is used as a fuel, the output being 107.15 kw (hours) per barrel of oil, the evaporation being 12.89 pounds of water per pound of oil; the present daily output is about 17,000 kw hours.

ST. ANTHONY FALLS WATER POWER PLANT.—"Amer. Elec.," May.—An illustrated description of this plant.

Traction.

RAILWAY RETURNS. Trotter, Cardew and Parshall. Lond. "Elec." and "Elec. Eng.," April 29; reprints of three short Institution papers, the latter being begun in the last named journal.—Trotter describes a graphical method for determining the fall of potential in the return feeder for a uniform distribution of current, and shows the proper point of application. He assumes the load to be equally distributed and then draws a rising curve, the abscissas for which are the distances and the ordinates, the losses in voltage; this curve is continued up to five volts, which is assumed to be the maximum allowable; from that point the curve is continued by being reversed by means of a templet, thus going downward; from a point corresponding to five volts at the end of the line the same curve is drawn downward to the left, and the intersection of this with the second curve then gives the proper point of application for the return feeder, and in the example chosen the loss of voltage at this point will be 2, which is the best that can be done in that case with a single return feeder; the length of the feeder is determined directly from the diagram, and its current is readily calculated. The diagram will of course vary with the conditions of each case, and it may be that several successive curves must be drawn, and hence several feeders used. Cardew's paper is a reprint of one prepared in 1894, and il-

lustrates the method which he suggested then, of introducing motor generators into the return feeders. There are two insulating feeders for each section, one for the line and one for the return current passing through the motor generator at the station, the field magnets of which are excited by the line current alone and the armature of which is wound with two circuits, one for each current, so as to oppose each other, the circuit through which the line current passes being made slightly more powerful; the motor generator will then revolve as determined by the line current and will generate an auxiliary voltage for the return current. The expense will probably prevent its adoption in many cases. Parshall's paper is on earth returns. He calls attention to the large surface leakage of the track, which he gives as "50,000 feet per route mile." By cutting the track and inserting an amperemeter he found in some recent tests that about 60 per cent. of the current was returned through the earth; tests showed that the conductivity of the earth was about 1.5 times that of the rails, indicating that an average of about 33 per cent. of the current was leaving the rails; he recommended insulating the rails from the adjoining earth; the conductivity of the earth he finds so great that the currents are not diverged from the earth by gas and water pipes. The conductivity of the rails and bonds before the track is laid should be determined, so that the earth currents can afterward be estimated, and that tests may indicate the general condition of the bonding. The results of bonding the rails to adjacent gas and water pipes have been more or less satisfactory, but he questions whether such bonding would prove effective in any considerable drop in the rails. Entirely satisfactory results have been obtained with lead sheathed cables running parallel to the earth returns. A general rule to prevent electrolysis in every case would be unnecessarily severe, as there are such differences in soils. Welding the rail joints has been tried, but the results are not encouraging; it reduces the electrical conductivity and softens the metal, while the rail takes a very high temper, decreasing its strength. In the cast welded joint there is a slight clearance for expansion and contraction, which accounts for the mechanical success of the joint, but there will be uneven wearing of the rail and the clearance admits a certain amount of moisture; the electrical resistance varies considerably, and such joints should therefore also be bonded. He then discusses bonds; with pressure contacts the area should correspond to 100 amperes per square inch, as determined by the best practice, but one-half of this would be more satisfactory; in his practice he does not exceed 25 amperes per square inch, and the contact resistance is then negligible as compared with the resistance of the rails. The results with cast copper have not been satisfactory. He has also used a separately excited generator in the return feeder, the magnet coil being in series with the trolley feeder, so that the voltage generated is directly proportional to the current output; the results were most satisfactory, and the machine works perfectly automatically.

ACCUMULATOR TRACTION.—Lond. "Elec." and "Elec. Eng.," April 29.—An abstract of a report made by a commission, to the city of Blackpool; this commission was to inquire into the advantages, disadvantages and cost of the accumulator system and to give an opinion on the adoption of this system for that city. They admit that the accumulator system has undoubted advantages, and is an ideal one if the question of cost need not be considered. The following data was obtained from the Tudor Accumulator Company: For a double truck car weighing 11 tons, with a load of eighty-six passengers, the weight of the accumulators for running 5 miles with one charge is 5 tons 4 cwt. complete; the space occupied would be 68 cubic feet; the maximum speed will be 12 miles; the guaranteed ampere hour efficiency 75 per cent.; the guaranteed cost of maintenance, 3.2 cents per car mile; to fit up a car with accumulators would cost $1850; the time for recharge would be ten to fifteen minutes. The cost of the overhead trolley system is given for comparison; the cost of the accumulator system compares unfavorably with that of the overhead; the cost of operation and maintenance is also given; the real efficiency of the cells in watt hours would be about 55 per cent.; the cost of maintenance is over four times as great as that of the trolley system. The commission came unanimously to the conclusion that the overhead trolley system is the only one that can be made both successful and remunerative in that city.

RAILWAY SCHEME.—Lond. "Elec. Rev.," April 29.—A brief account of what is claimed to be the most ambitious scheme of electric tramways ever promulgated in that country, involving lines to Uxbridge and to Hampton Court, near London.

SURFACE CONTACT SYSTEMS. Pellissier. "L'Eclairage Elec.," April 23.—Brief illustrated descriptions of several systems, taken apparently from patent specifications.

POWER FOR A CONDUIT RAILWAY.—"Eng. News," May 12.—A very brief extract of a test of the Lenox Avenue conduit railway, in New York, by Severs, published in the "School of Mines Quarterly," January; this is considered the best type of conduit street railway yet devised. The test was made with 300 volts and then with 500; the watt hours per car mile for the former was 1233, and at 500 volts it was 848. (It is not stated whether this is on the car or at the switchboard, but it is presumably the latter, as the note mentions the loss in the feeders.)

GRINDING CAR WHEELS.—"West. Elec.," May 7.—An illustration, accompanied by a brief description, of a device for grinding the wheels before they are mounted and after they have become worn, whereby their life is increased and the efficiency of the service is improved; it is claimed that considerable economy is effected by this method. The grinder is driven by a 15-hp motor, and consists merely of two emery wheels with a suitable stand for mounting and turning the wheels.

CAR ELEVATOR.—"West. Elec.," May 7.—An illustration, accompanied by a brief description, of an electrically driven elevator at a car station in Chicago, which raises the car to an upper floor for repairs. The elevator has a capacity of 10 tons, and is operated by a 30-hp motor.

Installations, Systems and Appliances.

COST OF GENERATING AND DISTRIBUTING ELECTRICAL ENERGY. Hammond. Lond. "Elec.," April 29.—A long abstract of the discussion of his paper (see "Digest," May 7); the first part of the discussion is given completely in the "Jour. of the Inst. Elec. Eng.," April; the latter part is published in the Lond. "Elec. Eng.," April 29, and is given in abstract in the Lond. "Elec. Rev." Webber thought the figures were not sufficiently accurate to give the engineer much usful information from which to draw conclusions as an engineer; the extreme divergence of the order of merit of several stations showed how completely unreliable such statistics are in forming an opinion on the efficiency of the use of the coal; the figures are nothing more than suggestive. Crompton thought the paper was of great interest and discussed some features of it; he called attention to the risk of direct generation at high voltage; such coils fail completely if there is a breakage of the steam pipe in the station; it seems necessary always to generate at low voltages and transform up. Wordingham thought it was a mistake to discuss the cost of supply, leaving entirely out of consideration the capital cost. Smith pointed out some inconsistencies in the figures and called attention to the fact that the good working of a station depended more on the engineer than on anything else. Kennedy thought the figures gave much information, and were easily interpreted with accuracy and benefit; the problem was one of enormous complexity; he did not rank the load factor as high as Hammond. Lawson also called attention to the question of capital; at Dover the lighting station had a traction load and the result was very gratifying, as it reduced the cost of production at least 2 cents per unit. Sayers recommended the use of wattmeters at the station switchboards, preferably on the mains' side. Cowan said he tried American, German and English meters, but none of them would work accurately on circuits carrying large currents. Geipel objected to the statement that engineers had nothing to say in controlling the costs outside of the works costs, as the amount of the constant charges is largely controlled by the policy adopted by the engineer in laying out the works and in choosing the proper location; this question is too important to be placed beyond the engineer's jurisdiction. In Hammond's reply he suggested changes in the Board of Trade rules.

ELECTRICITY SUPPLY. Gibbings. Lond. "Elec.," April 29.—In this continuation of his serial (see "Digest," last week), he considers the subject of charging for electrical energy, showing how the rate of charging is determined. He divides the costs into the cost of generation and constant charges, as an arbitrary figure which must be used when a station begins its supply; the maximum price per unit is now generally understood to be that price which would cover the entire cost of production if the maximum demand was a constant and uniform rate of supply for one hour per day throughout the year. A table gives the hours per year for maximum demands for 1000 watts upwards for a daily average of one to twenty-four hours. The usual method of charging is based on the assumption that all the items forming the cost of production should be entirely paid out of the first hour's daily average demand.

DISTRIBUTION OF ELECTRICAL ENERGY IN GERMANY. Laffargue. "L'Ind. Elec.," April 25.—An abstract of a recent paper read before the International Society, giving the results of a recent visit to a number of stations in Germany; the information for each of a number of stations is quite brief. A translation is published in the Lond. "Elec. Rev.," April 29.

PARIS. Laffargue. Lond. "Elec. Eng.," April 29.—The beginning of a reprint of an illustrated article on the distribution and the central stations in that city.

PARIS.—"L'Energie Elec.," April 16.—A long, illustrated description of the new station at the Quai Jemmapes.

STATISTICS OF ENGLISH LIGHTING PLANTS.—Lond. "Elec. Eng.," April 29.—An unfavorable criticism of the series of articles by D'Oyly, which was noticed in the "Digest," April 23.

CENTRAL STATION ACCOUNTS.—Lond. "Elec.," April 29.—Analysis of the accounts of the Hastings and St. Leonards-on-Sea and the Newcastle-upon-Tyne stations.

LIGHTNING ARRESTER.—"L'Ind. Elec.," April 25.—An illustrated description of the Alioth arrester, in which the discharge is carried to earth through a lever which breaks the circuit by means of an electromagnet and automatically sets itself again after the circuit has been broken. The break takes place between two carbon blocks, which are separated by a short gap, which is a function of the normal voltage.

REGULATION IN CENTRAL STATIONS. Chapman. "Amer. Elec.," May.—The importance of voltage regulation in central stations is dwelt upon, and the principles described of a device by means of which close regulation may be attained. The principal

feature of the apparatus described is the use of differential coils; an iron core is subjected to magnetization from two solenoids, each having a differential winding; normally each solenoid has a current in only one of these two windings, the action on the core thus being neutralized; when the second coil of either solenoid is automatically put into circuit by a change of voltage it neutralizes the other coil, thus enabling the second solenoid to act upon the core. By this means it is claimed that inductive sparking at the regulating contacts is entirely obviated.

M'GILL UNIVERSITY.—"Can. Elec. News," May.—A brief, illustrated description of the electrical plant at the Engineering Building at this university.

NAVAL MARINE ELECTRIC LIGHTING. Countiss. "Amer. Elec.," May.—A standard naval electrical installation is described and illustrated, including various details.

POWER COMPANIES AND THEIR RELATION TO MUNICIPALITIES. Lang. "West. Elec.," May 7.—A reprint of a lecture at the Purdue University.

CENTRAL STATION WORKING. Stirling. "Amer. Elec.," May.—The care and testing of alternating recording meters is considered.

Wires, Wiring and Conduits.

PAYMENT SYSTEM OF HOUSE WIRING. Zingler. Lond. "Elec. Rev.," April 29.—The conclusion of his article (see "Digest," last week). He continues the discussion of the system proposed by Rider, answering the claims made for it. He then compares it with the scheme of the Free Wiring Company (which is not described) and shows that the quarterly bill in a certain case would be exactly the same as with Rider's method, but it appears that the consumer would pay the same amount continuously, although he has the option of purchasing the installation after five years. The latter system is now being used by many companies.

HIGH VOLTAGE TRANSMISSION LINE. Dailey. "Amer. Elec.," May.—Detailed instructions are given for the laying out of a transmission line and the preparation of the poles for erection. The choice of route is considered and instruction is given for the setting of poles and their gaining, in order that the pole line shall present the best possible appearance.

SWITCH FOR HIGH VOLTAGES. van Deth. "Amer. Elec.," May.—A switch is described having no moving parts in circuit, consisting principally of a mercury cup having a rubber bottom. To open the switch an arm is tripped, the support of the rubber bottom drops and the level of the mercury in the cup falls, thereby breaking contact with one pole of the circuit, which dips into the mercury when the circuit is closed.

INTERIOR WIRING. Knox. "Amer. Elec.," May.—The method of deriving the usual wiring formula is given, and the application of the formula to the calculation of various kinds of branch circuits is described.

Electro-Physics and Magnetism.

X-RAY TUBE. Villard. "L'Eclairage Elec.," April 23.—A brief illustrated description of his tube, which can be regulated. There are two cathodes in two separate branches of the tube, but both focused on the same focusing plate; one is small and the other large; when the resistance of the tube becomes too high they are both connected to the source, thus increasing the cross section of the beam; when this becomes insufficient the cathode is connected to an aluminum spiral in another branch of the tube and a current is passed for a very short time, disengaging the gases, which again reduces the resistance.

TRANSFORMATION OF X-RAYS. Hurmuzescu. "L'Eclairage Elec.," April 23.—A reprint of a short paper read at the conference of the French Physical Society. He describes certain experiments and offers a hypothesis.

DEFLECTION OF CATHODE RAYS. Schmidt. "Elek. Zeit.," April 28.—Abstracts of two articles from a German scientific journal on the deflection of cathode rays by electric oscillations.

ACTINO ELECTRICITY. Schmidt. "Wied. Ann.," No. 4; abstracted briefly in the Lond. "Elec.," April 29.—He endeavored to discover some relation between the ionization of a body and its fluorescence on recombination and also between the latter and its photo-electric sensitiveness. One of the results obtained was that those bodies which exhibit the strongest thermo-luminescence, that is, fluoresce most strongly on heating after exposure to cathode rays, show also the strongest dissipation of negative charges under the influence of light.

MECHANICAL CONCEPTIONS OF FRICTIONAL ELECTRICITY. Weyde. "Elek. Zeit.," April 28.—An illustrated article suggesting a method of conceiving what takes place in the production of frictional electricity based on a conception of whirling molecules.

EXHIBITION OF FRENCH PHYSICAL SOCIETY.—"L'Eclairage Elec.," April 23.—A long account consisting of brief descriptions of the exhibits of interest to electricians; (some of these and the three papers read at the conference are noticed under their respective headings).

THEORY OF MAGNETIC DISTRIBUTION. Morin. "L'Eclairage Elec.," April 23.—A reprint of a long paper read at the conference of the French Physical Society, on the relation between the magnetization of magnetized needles and their length, and a suggestion of a theory of the magnetic distributon. He gives the results of some tests to determine the relations between the magnetization and the three dimensions of a magnet, discusses the location of the poles and the distribution of the magnetisms, after which he suggests a theory to agree with these facts.

PRACTICAL APPLICATIONS OF CONDENSERS.—"Amer. Elec.," May.—The application of the condenser in connection with the inductance is described, whereby a constant current may be obtained from a constant potential circuit, or a constant potential from a constant current circuit. The theory is explained in simple terms and numerical examples given, showing how to calculate the data for a condenser and inductance for a given case.

ELECTRICITY. Tyler. "Amer. Elec.," May.—It is proposed to define the volt as the unit of effort to electrify, the ampere as a unit of degree of electrification, and the ohm as the unit of persistency to remain unelectrified. Instead of ampere he would use the term degree, which would be the product of effort by resistance. He believes that the real import of the terms volt, ampere and ohm is much more comprehensible when thus expressed, and that the popular misconception that electricity is a substance will end if this system of nomenclature is adopted.

ELECTROMAGNETS FOR LIFTING PURPOSES.—"Cassier's Mag.," May.—Brief reference to this use of electromagnets. Such magnets are in constant use at the Sandycroft foundry in England, where they are applied to lifting pieces of iron and steel weighing as much as 3 tons. For 1-ton weights the magnets weigh 250 pounds and require 2 amperes at 110 volts, the current being obtained from the lighting circuits; they are of the two-pole type, and there is nothing unusual in their construction. Such magnets have been also in daily use at the Woolwich Arsenal for over five years, for handling heavy projectiles weighing 1800 pounds; they are much more convenient, as it was formerly very difficult to get slings around the projectiles; the magnets require one-eighth horse-power for lifting a weight of 3600 pounds, the weight of the magnet being about 45 pounds.

Electro-Chemistry and Batteries.

PRODUCTION OF OXYGEN COMPOUNDS OF METALS. Otto and Strecker. Lond. "Elec.," April 29.—An account of their experiments to determine the conditions under which these operations can be carried out with the highest efficiency and greatest economy; the results are given in tables. They ascertained the effects of the electrodes on the efficiency and found that considerable economy can be effected by choosing the proper electrodes and the proper composition and density of the electrolyte. A table shows the required voltage with electrodes of different metals and in two different solutions, other conditions being the same; for instance the production of a compound of aluminum from an anode when the same metal is used for the cathode requires 2.2. volts, while if lead is used for the cathode it is only 1 volt, showing a saving of 55 per cent.; between two zinc electrodes it is 1.1 volts, while between zinc and iron it is 0.1, showing a saving of 91 per cent. The most economical conditions for the production of oxygen compounds of a number of metals are given in a table, the solutions best suited being sodium cloride, chlorate and sulphate, at the concentration of their maximum conductivity. When the electrolyte consists of two salts, one as solvent and the other as precipitant, the quantity of the one which is to dissolve the anode should be that required for a solution of maximum conductivity, while the quantity of the other salt is obtained by calculation to correspond to the precipitation. As solvents alkaline chlorates are specially suited, while for precipitants salts of carbonic, chromic, phosphoric or other acids with the alkalies are preferable; the precipitation is very pure and finely divided. An example is given.

ELECTRICAL QUALITIES OF CHROMIUM. Hittorff. "Elek. Zeit.," April 28.—An abstract from the Proc. of the Academy of Sciences of Berlin. He investigated the electrical properties of this metal and found that it had the property of being passive like iron under certain conditions, in electrolytes, and in this condition it acts like one of the noble metals, being then at the electro-negative end of the list of metals with platinum. It also has the property of being active and is then behind zinc in this list, and will replace metals which are more electro-negative. It also takes a position between these two.

LEAD-ZINC ACCUMULATOR. Werner system. "L'Ind. Elec.," April 25.—A brief description. The E. M. F. is 0.3 to 0.4 volt higher than that of the ordinary lead accumulator, and the specific capacity is greater; the electrolyte is a solution of the sulphates of zinc, cadmium and magnesium; during the charge a deposit of zinc and cadmium is formed on the negative plate, together with a quantity of hydrogen, which is chemically combined. For obtaining a good deposit the solution should be concentrated, but in that case the peroxide of lead plate does not act so well and the voltage falls more rapidly; it is for this reason that he adds the sulphate of magnesia, as the deposit will then be very good, even when the solution is more dilute and therefore more favorable for the positive plate. For six hour discharges he makes negative plates of thin sheet iron covered with lead; the charge is stopped when about 60 per cent. of the solution is decomposed; the loss on open circuit depends on the electrolyte and the quality of the deposit; in certain cases it is only 3 per cent. per day, and this affects only the negative plate. For

rapid discharges the solution cannot be concentrated, and much hydrogen is produced which should not be allowed to escape; the negative plates are therefore made of grids, which are very thin and light and are covered with a paste of lead and spongy cadmium, subjected to great pressure, the pores of which will retain the hydrogen; there is practically no loss in these on open circuit; it can be charged and discharged in 2.5 hours. The positive plate is first formed before it is pasted, and it is then subjected to great pressure. According to the inventor, the capacity is 82 watt hours per kg of plates at 12 to 15 amperes, which corresponds to 36 watt hours per kg of complete accumulator. An electric carriage on which these have been used in London for the past month contains 334 kg of batteries, consisting of 30 cells of 180 ampere hours each, the rate of discharge being 30 amperes; it will give a useful output of 1.5 horse-power during six hours.

ACCUMULATOR CONSTRUCTION. FitzGerald. Lond. "Elec. Eng.," April 1 and 29.—The continuation of his long serial. He discusses celluloid and similar compounds and then begins the subject of rate of discharge and concentration of the acid; he concludes that the density of the electrolyte prior to the discharge would not exceed 1.263, and that at the end should not be much below 1.182. A discussion of the weight of acid required is then begun.

VARIATION OF THE CAPACITY OF ACCUMULATORS WITH THE DISCHARGE. Loppe. "L'Eclairage Elec.," April 23.—An abstract with a number of the tables of the article, a short abstract of which was noticed in the "Digest," March 26. He confirmed the formula of Peukert.

ELECTROLYTE FOR LECLANCHE CELLS.—"Elek. Zeit.," April 28, and "Elek. Anz.," April 24.—A note stating that the material which is called "salmiakcalcidum," a notice of which appeared in the "Digest," January 2, 1897, has given very satisfactory results on a German railway telegraph line; it is used as a solution for Leclanche cells, and appears to be a secret product made by a German company. Owing to its tendency to absorb water, it could not be transported dry, but this objection has now been overcome, and it is now dried in vacuum and transported in air-tight vessels; it is readily dissolved in water and the concentrated solution has the properties of both sal ammoniac and of "calcidum."

CONDUCTIVITY OF SOLUTIONS OF PERMANGANATE OF POTASSIUM. Legrand. "L'Ind. Elec.," April 25.—An abstract of an Academy paper giving the results of some determinations.

CONDUCTIVITY OF MIXED SOLUTIONS. Hopfgartner. Lond. "Elec. Eng.," April 29.—A brief abstract of a recent paper.

CONDUCTIVITY OF SOLUTIONS. McKay. "Trans. Nova Scotian Institute of Science," Vol. 9; reprinted under separate cover.—A description of researches made to test the possibility of calculating the conductivity of mixtures of solutions of the chlorides of sodium and barium by means of the dissociation theory of electrolytic conduction. From the results he concludes that such a calculation is possible, at least for solutions whose concentrations are not above 2 gram-equivalents per liter.

CONDUCTIVITY OF SOLUTIONS. Archibald. "Trans. Royal Soc. of Canada," Second Series, 1897-'98; reprinted under separate cover.—An article on the calculation of the conductivity of aqueous solutions containing sodium, chloride and potassium sulphate. It is presumably the same paper as was noticed in the "Digest," February 12.

THERMO-ELECTRIC BATTERY. Reed. "Elec. Rev.," May 11.—The beginning of a reprint in full of his Institute paper, which was recently noticed briefly in THE ELECTRICAL WORLD.

OXIDE OF COPPER BATTERIES.—"Sc. Am.," May 7.—An illustrated description of the recent improvements of Lalande of his battery, which were noticed in the "Digest," January 22. It is reprinted in the "Elec. Rev.," May 11.

THERMIC MERCURY AMPEREMETER. Carmichel. "L'Elec.," April 23, and "L'Ind. Elec.," April 25.—A reprint of an Academy paper supplementary to the one referred to in the "Digest," March 5. It was thought that the excessive heating of a column of mercury in that instrument would cause errors, but he now shows that this is not the case, as the heat developed by the current is transmitted immediately to the reservoir. He now shows how this instrument can be used as a standard of E. M. F. of great constancy; this consists merely in using the instrument as an amperemeter, the current passing through a standard resistance; voltages from 1 to 16 can thus be accurately indicated. "L'Eclairage Elec.," April 23, reprints a paper by Carmichel read at the conference of the French Physical Society, on standardizing apparatus, in which he describes this thermic amperemeter.

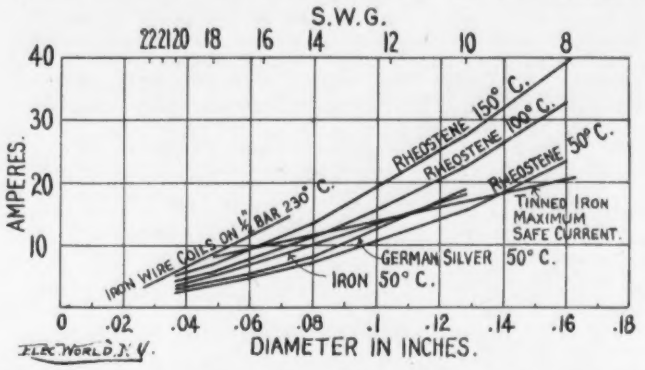
CIRCUIT BREAKER. Cremieu. Lond. "Elec. Rev.," April 29.—A translation, with the illustration, of the article noticed in the "Digest," April 9 and March 19.

MERCURY PUMP.—"L'Eclairage Elec.," April 23.—A brief, illustrated description of the Chabaud vacuum pump, which is claimed to be simple and cheap, and contains no stop cocks.

INTENSITY VARIOMETER. Heydweiller. "Wied. Ann.," No. 4; noticed briefly in the Lond. "Elec.," April 29.—A description of an apparatus for measuring the variations of the intensity of the earth's field; it is particularly suited for balloon and ship observations.

Units, Measurements and Instruments.

CARRYING CAPACITY OF RESISTANCE MATERIALS. Atkinson. Lond. "Eec.," April 29.—A reprint of the accompanying



diagram, which was omitted from the previous reprint, noticed in the "Digest," last week. It gives the carrying capacity of bare wires stretched straight in the air, for the indicated temperatures; if the wires are in coils such that the space between the wires is about two diameters, the current which they will carry is about one-third of that in the diagram for the same temperature. The conclusion of the complete paper is published in the Lond. "Elec. Eng.," and an abstract is begun in the Lond. "Elec. Rev."

UNIVERSAL GALVANOMETER.—Lond. "Elec." and "Elec. Rev.," April 29.—An account of some recent tests made with the Sullivan galvanometer on a torpedo boat running at various speeds, the object being to determine the effect of the excessive vibration, which was so great that a glass of water on a table was half emptied in a few minutes. The results were very satisfactory. In another test it was mounted on about one inch of felt pads, the corners being secured laterally through fixed pins by means of rubber bands, which kept the instrument from shifting, but transmitted no vibrations; the disturbances were thereby reduced still more. An ordinary and less sensitive iron clad marine galvanometer mounted alongside and in the same way, vibrated so much that observations were out of the question.

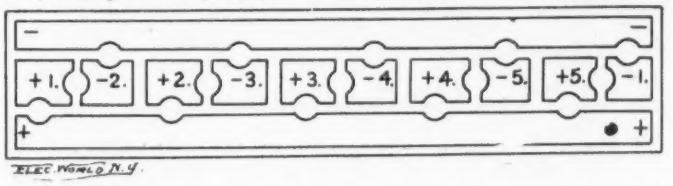
QUADRANT ELECTROMETER. Elster and Geitel. "Wied. Ann.," No. 4; noticed briefly in the Lond. "Elec.," April 29.—Descriptions of some improvements. The air is dried by means of a piece of metallic sodium placed in a wide-sided tube; the damping apparatus consists of a flat, horizontal plate dipping into petroleum. The chief advantage of the instrument is its constant zero.

MEASUREMENT OF THE DIP. Meyer. "Wied. Ann.," No. 4; abstracted briefly in the Lond. "Elec.," April 29.—He describes a method for measuring the magnetic dip without a magnet or a galvanometer. He finds the position in the plane of the magnetic meridian at which the half revolution of a coil produces no current; the inductor is kept moving and is tested for alternating currents by means of a telephone; the neutral position is found easily and with great accuracy; deviations of less than three minutes produce a distinct alteration in the sound. A modification enables it to be used for measuring the earth's horizontal force; the revolving coil is surrounded on both sides by large coils through which a current is sent opposing the earth forces; when no noise is heard in the telephone the artificial field and the earth's field are equal, and the former may then be readily calculated.

MEASURING DIFFERENCES OF PHASES. Rossi. "L'Eclairage Elec.," April 23.—The first part of a long mathematical article on the measurement of phase differences between sinusoidal currents, by the method of Lissajous and the Ferraris field.

MEASUREMENT OF ELECTRIC OSCILLATIONS. Bergmann. "Wied. Ann.," No. 4; abstracted in the Lond. "Elec.," April 29.—He describes an arrangement for studying electric oscillations whose periods exceed one-millionth of a second; no experimental results are given.

PLUG SWITCH FOR CONNECTING BATTERIES. Lohse. "Chem. Zeit.," 22, page 158; noticed briefly in the "Zeit. f. Elektrochemie," April 20.—He describes the following simple arrangement of a plug switch for connecting a number of separate batteries in series, multiple or any other desired grouping. The diagram ex-



plains itself; the two upper bars are for the line circuit and the blocks represent the terminals of the batteries, cell 2, for instance, being connected to the second and third block, as shown by the numbers, and cell 1 being connected to the first and last; twice as many blocks are required as there are cells.

Telegraphy, Telephony and Signals.

SUBMARINE CABLES IN TIME OF WAR.—Lond. "Elec. Rev.," April 29.—A reprint from a London daily paper, of an interview of an authority on the subject. The cables between Key West and Havana belong to an American company, but those from Cuba to Jamaica are both British property. He believes that there is nothing to prevent any belligerent from cutting cables belonging to a neutral company, but that country or the company owning the line would have a claim against the offending power for the destruction of property. Spain has communication with both of her possesssions in the West Indies without touching American territory. There is also a way of reaching Jamaica and Cuba by way of South America via Chili, but this contains a link owned by Americans, and the Spaniards would therefore be reluctant to use this route. In the route along the east coast of South America the section from Para to Cayenne is invariably broken.

MORSE WRITER.—"Elek. Zeit.," April 28.—An illustrated description of the instrument devised by Tribelhorn and used in the Argentine Republic.

AUTOMATIC CURB TRANSMITTER. Tobler. "Jour. Telegraphique," April 25.—A long, well illustrated description of the Muirhead instrument.

PROTECTING TELEPHONE CIRCUITS.—"Elek. Zeit.," April 28.—An editorial on the destructive fires which were started by currents from power or lighting circuits due to the contact of those lines with telephone lines; it refers more especially to the recent fire in Zurich. It is urgently recommended that fuses should be inserted in the telephone circuits.

TELEPHONY IN GREAT BRITAIN.—Lond. "Elec.," April 29.—A note stating that according to Gaine the total number of subscribers in Great Britain is now 106,000, which corresponds to one telephone for every 300 inhabitants; the corresponding figure for Germany is 400, for France 1200, Austria 1500, Belgium 680, and Holland 1000. A comparison on these lines, however, is not of much importance; Stockholm has one telephone for every twenty-four inhabitants, and the town of Manhattan, in Kansas, has one for every twenty-three.

DEVELOPMENT OF TELEPHONY IN AUSTRIA.—"Zeit. fuer Elek.," April 24.—The first part of a long descriptive article on the Government system of telephones; it is not illustrated, and appears to be chiefly of local interest.

AMERICAN TELEPHONE PRACTICE. Miller. "Amer. Elec.," May.—The present installment of this serial deals with the express system, the multiple jack system of Sabin and Hampton being described. The express system is spoken of in favorable terms, and while it is stated that the multiple system has met certain requirements with a degree of success, better, perhaps, than any other, it has such grave faults, due to its very nature, that it is questionable if the multiple board can survive long in this age of constant improvement. The express system described has been used for several years in San Francisco, where it has demonstrated its capability of handling with success an exchange having over 6000 subscribers.

CIPHER CODES.—"Teleg. Age," May 1.—A description of the secret system of codes used by the United States Government. It is similar to that used by other governments, and it is necessary to know not only the key word agreed upon, but also the agreement by which the key word is to be applied to the code.

WORKING OF LONG SUBMARINE CABLES. Sayers and Grant. "Sc. Am. Sup.," May 7 and 14.—A reprint of the illustrated article noticed in the "Digest," July 24, August 7 and October 16, 1897.

Miscellaneous.

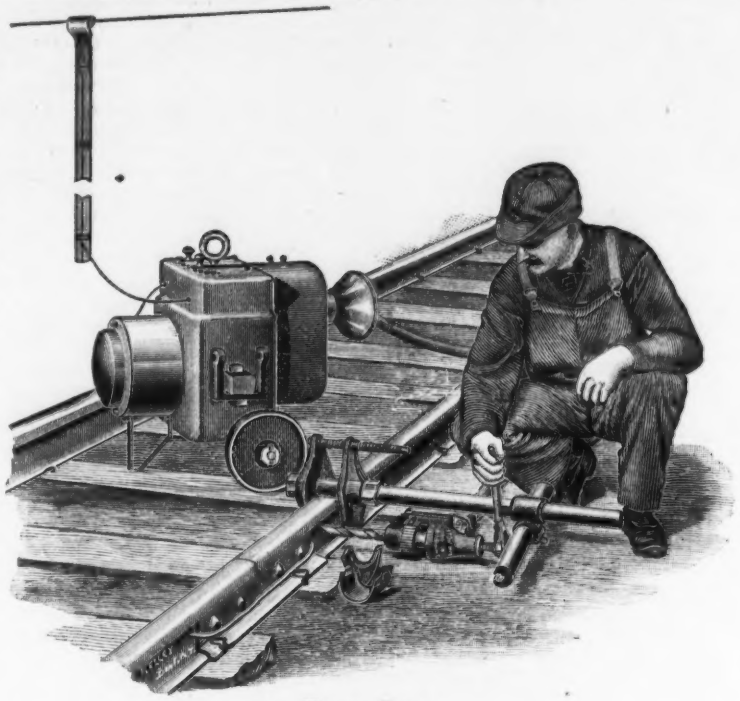
EXPLOSION OF FIRE DAMP. Couriot and Meunier. "L'Ind. Elec.," April 25.—An Academy paper supplementary to the one noticed in the "Digest," April 23. They show that there are conditions under which a spark will not explode a mixture of the explosive gases; this is the case when the two points of the conductor between which the spark is produced are connected or shunted by a secondary conductor; when this shunt has a high resistance the spark will ignite the mixture; the limiting conditions are discussed.

ELECTRICAL BURNS.—"Amer. Elec.," May.—A case of a severe electrical burn is described, which was cured by the application of an antiseptic known as vitogen; this, which comes in the form of a powder, was sprinkled lightly over the surface, and over that a cloth laid, saturated with linseed oil.

AURORA. Stuart-Smith. "Elec. Eng'ing," May 1.—An abstract of a recent article by McAdie in "Century," October.

A Portable Track Drilling Plant.

An iron-clad combination for track drilling is illustrated herewith. This apparatus, which is made by the Stow Manufacturing Company, Binghamton, N. Y., has been in successful operation for general purposes for over two years, but the special type for track drilling has been but recently perfected. This combination is said to be a great improvement on the older type which the company previously manufactured for this purpose. The machine is practically dustproof, waterproof and unbreakable, and is particularly fitted for the rough usage and exposure incident to track work. A ½-hp iron-clad motor drilling plant for general shop work is on exhibition at Madison Square Garden by the Edison Electric Illuminating Company of New York.



Track Drill.

It will be noticed from the illustration that the power is transmitted from the motor to the drill by means of Stow flexible shafting, and the current for the operation of the motor is taken from the overhead trolley wire by means of a hook.

An Improved Electric Bell.

An electric bell of new design is being furnished to the trade by the Western Bell Works, Chicago, Ill. The illustration shows that it embodies some new ideas in bell construction. There is only one magnet. The magnet heads, which are of soft iron, are square. Two of the edges of the magnet heads constitute the poles of the magnets, the armature consisting of a square, flat piece of soft iron sufficiently large to cover the two opposite edges of the magnet

Electric Bell of New Design.

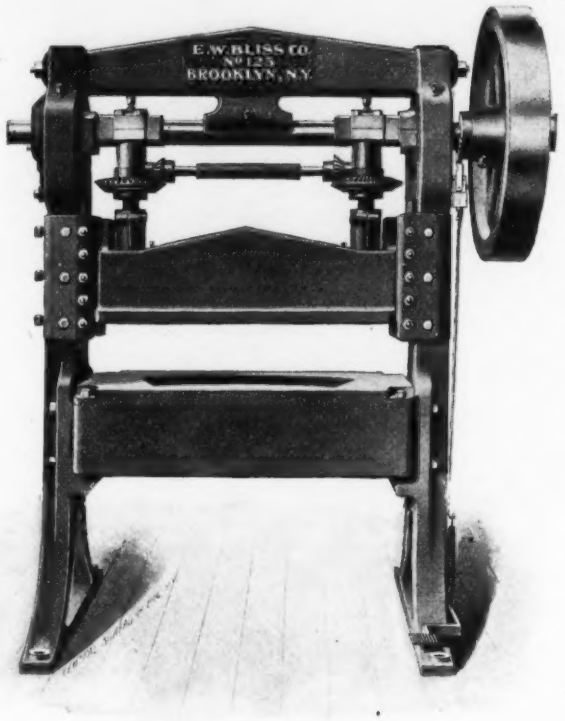
heads. The magnet is about five-eighths of an inch long, and consequently the square, flat armature is the same size on each side. Attached to the armature is the hammer lever, which has its fulcrum on a stud just inside of the circular bell box. A light spring keeps the armature in its normal position. The mechanism of the bell is all contained in the circular box, which is cast with the frame, all in one piece. The box is provided with a tight fitting cover of light, thin metal, and the bell complete is very compact.

The advantages claimed for the bell are that it is strictly high grade, combining in its construction the best materials and skillful workmanship. The arrangement of the mechanism is such that the derangement of the same from wear, corrosion, dust or other causes is reduced to a minimum. It is said to be extremely sensitive in action. Only one fixed adjustment is required to operate the bell under any conditions. There are no soldered contacts or connections, and all parts are rigid. The bell is said to be peculiarly adapted to be operated on railroad trains or under similar conditions, because its action is not affected by jarring.

Double Crank Presses with Composite Frames.

Double crank presses are now being used in so many different lines and for so many different purposes that a large variety of types have sprung into existence in order to meet the requirements in each case. The alterations required in the beds and slides to answer for dies of different shapes and sizes have been such that in the lighter styles of these presses it has become expedient to make the frames of several pieces instead of casting them all in one. In this manner the same patterns can be used for the housings and the change in the slides, beds, and crown pieces can be more economically made.

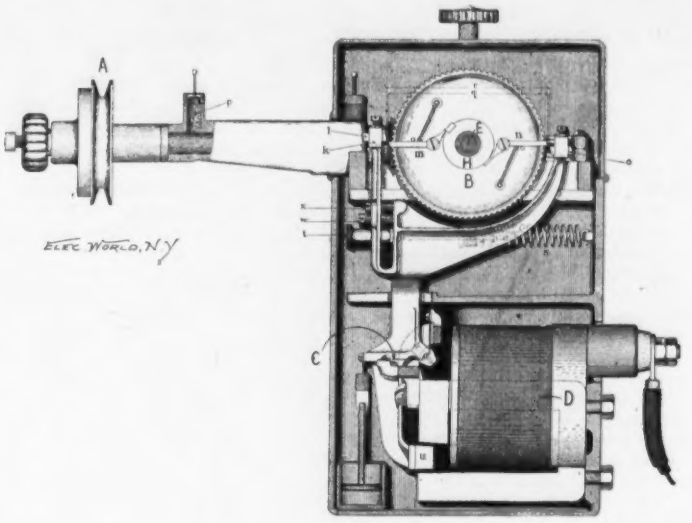
The illustration shows a press of this type, which is furnished with beds of various shapes and sizes and with a distance between housings that can be varied from 36 to 66 inches. The cut shows a machine 48 inches between the uprights, which is intended for cutting large section blanks in the manufacture of armature discs. The new Bliss clutch used in these machines insures immediate response to the treadle action, permits of turning the shaft back by means of the wheel, to release the punch when stuck in the die, and may be locked, so as to obviate the necessity of removing the belt when setting dies. The adjustment of both pitmen is made simultaneously, and the two screws are readily secured by clamping sleeves after the proper position has been given. The ways are long and wide and adjustable for wear in every direction. These presses are made with or without gearing. Another series of presses of this style with the same general dimensions, but much heavier in the shafts, housings and other parts, is also represented in the illustration. The weight of these heavier series of presses range between 8000 and 11,000 pounds for fly wheel style, and from 9000 to 12,000 for the geared presses. The total weight of the machine shown, which is built by the E. W. Bliss Company, 12 Adams Street, Brooklyn, N. Y., is 4700 pounds. It carries a 36 x 5-inch fly wheel, weighing 750 pounds, on a 3-inch shaft.



DOUBLE CRANK PRESS.

A New Arc Dynamo Regulator.

The Western Electric Company has brought out a new style of regulator for its arc dynamo machines, embodying some interesting improvements over previous practice. The design of this regulator is shown in part in the accompanying sectional elevation. As heretofore, the regulation is effected by simply shifting the brushes to proper points on the commutator for collecting a voltage suited to the load, the brush rocker being attached to a screw working in a nut in such a manner that any endwise motion of the screw moves the brushes. The screw appears at *E* in the accompanying diagram, and the nut at *H*. These two parts are rotated in the same direction, respectively, by the triggers, *m* and *n*, attached to the disc *B*, which is driven by bevel gears, as shown from the pulley *A*, belted to the main shaft; *l* and *o* are steel dogs mounted in the forked rocker, which is pivoted at *C* and carries at its lower end the armature, *u*, controlled by the magnet, *D*, in series with the main line. If the line resistance increases, weakening the current, the armature, *u*, is withdrawn by the action of the tension spring, *s*. The dog, *l*, engages the trigger, *m*, lifting it out of the notch in the nut, *H*, which is then stopped by a small friction band not shown. As the screw is compelled to continue its rotation by the trigger, *n*, engaging in a notch in a sleeve keyed to the screw, the latter moves endwise when the nut is stopped, advancing the brushes to a position of greater potential difference. On the other hand, when the line resistance falls, thereby increasing the current, the armature, *u*, disengages the dog, *l*, from the trigger, *m*, and further engages the dog, *o*, with the trigger *n*, stopping the screw instead of the nut and moving the brushes in the other direction. The control is steadied by a dash pot, shown in the illustration. An interesting detail of the control is the method of pivoting the rocker. Instead of mounting it upon a pin, it is fixed to flexible springs, *C*, in such a way that it is free to move slightly in the proper direction, but rigid in all others. This gives no opportunity for sticking or binding on the pivot. The dash pot is similarly connected. The intent of the design was the production of a controller without sparking contacts, which in course of time are likely to become corroded, or friction clutches which are likely to wear. The force supplied to the brushes is derived from the main shaft, thereby giving plenty of power, the control being effected by a sensitive magnet with very light duty.

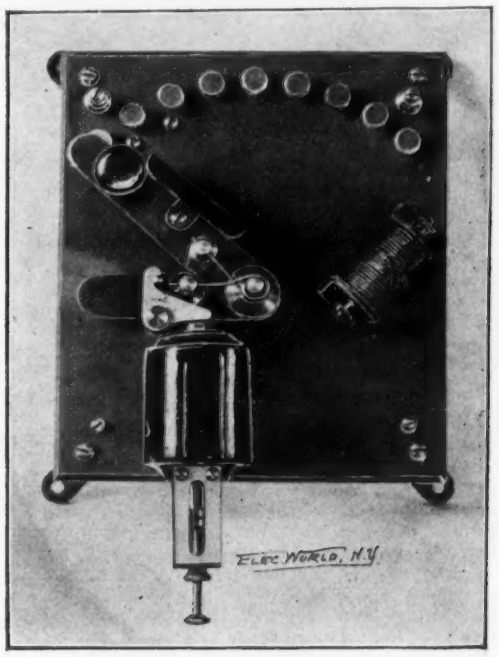


ARC DYNAMO REGULATOR.

Under Voltage and Overload Automatic Motor Starter.

We present herewith an illustration of the latest type of under voltage and overload automatic motor starter of the Ward Leonard Electric Company, Bronxville, N. Y., for motors of moderate size.

The patented double lever, which has met with much favor, is retained in this type. The switch lever is held normally closed by a latch which, upon overload current, is released by the plunger of the vertical solenoid magnet.



AUTOMATIC MOTOR STARTER.

The rheostat lever is normally held closed by a magnet in the main circuit, so that in case the current fails the rheostat lever automatically moves back to the starting position.

The switch parts are mounted upon a slate front as shown. This slate forms the front side of a shallow cast-iron box in which the resistance wire is placed. The resistance coils are embedded in a mass of material which is highly insulating and has a very high capacity for the absorption of heat energy developed in starting the motor. No asbestos, enamel, cement or other materials are

employed in this rheostat, for which the Ward Leonard Company makes the strongest claims.

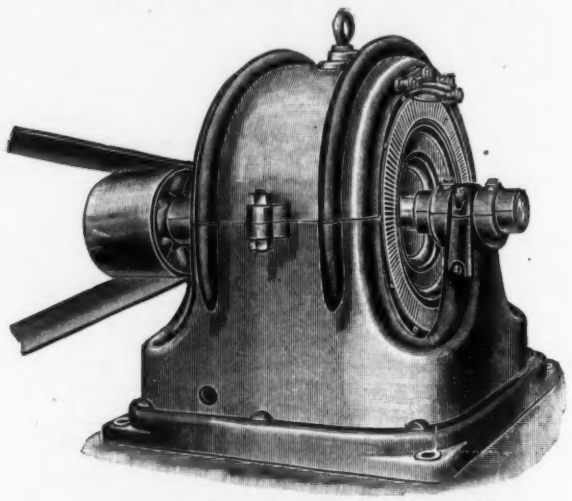
While the Ward Leonard Company claims superiority for this rheostat on every point, it is offering it to the trade at one-half the price it has heretofore quoted for similar apparatus. It explains that this is due to careful design, special tools and new economical processes of manufacture, together with the greater cheapness due to manufacturing in very large quantities.

An Improved Inductor Alternator.

The Warren-Medbery Company, Sandy Hill, N. Y., has recently produced an inductor type of alternator which is claimed to be the latest development in this class of machines. The accompanying illustrations show the machine complete and some of its details. The cuts were made from photographs of a 150-kw machine recently installed in the station of the Ballston Electric Light & Power Company, Ballston Spa, N. Y.

The lower half of the frame of this machine, with the base and supports for bearings, constitutes a single casting, insuring great strength and rigidity in the machine, guaranteeing the accurate centering of the revolving inductor while assembling the machine and maintaining perfect alignment while in operation. The bearing sleeves are lined with a high grade of anti-friction metal, the bearing surfaces are unusually large, and the peripheral speed of the shaft in the bearings is moderate. The bearings are self-oiling from an oil reservoir of large capacity, and the distribution of oil throughout the bearings is abundant, being effected by a peculiar arrangement of oil ducts in the interior of the bearing sleeves. The bearing sleeves are made solid, as being the most convenient form for babbitting, in case it should become necessary to reline the bearings. The supports for the bearings are so designed that when it is desired to remove a bearing sleeve the only operation necessary is the removal of the bearing cap, after which the sleeve may be slipped endwise off the shaft.

The sub-base carries polished steel skids, and the machine rests upon these skids with an interposed layer of babbitt, accurately shaped to the configura-



Inductor Alternator.

tions of the skids. By means of a powerful ratchet and adjusting screw the belt tension may be easily and quickly regulated.

By the removal of the two frame bolts, and opening the armature circuit on the horizontal central line, the upper half of the frame may be lifted away from the machine. The upper half of the machine carries the upper half of the armature and the corresponding armature coils. The revolving inductor is surrounded at its smaller end by the field coil, which latter is attached to an annular yoke casting. After the upper half of frame and armature are removed, the revolving inductor, field coil and yoke may be lifted out. By this method of construction all of the coils of the machine are readily accessible for inspection and repairs.

The armature body is built up of a special grade of soft steel, and the methods of handling the metal prevent any injuries to its structure which would increase the losses due to magnetization. For the armature, metal of a very thin gauge is used, and the sheets are served on both sides with an insulating compound which is not affected by heat or age. By this means the armature eddy currents are thoroughly broken up, and practically no loss of power occurs from heating. In addition to this there are a series of recesses between the cast frame of the outer circumference of the armature which admit of the free circulation of air entirely around the armature. These recesses are entirely internal, and the exterior of the frame casting is retained smooth and symmetrical, without unsightly openings for ventilation purposes. The machines operate remarkably cool, as no part rises over 50 degrees Fahr., even when operated continuously under 10 per cent. overload.

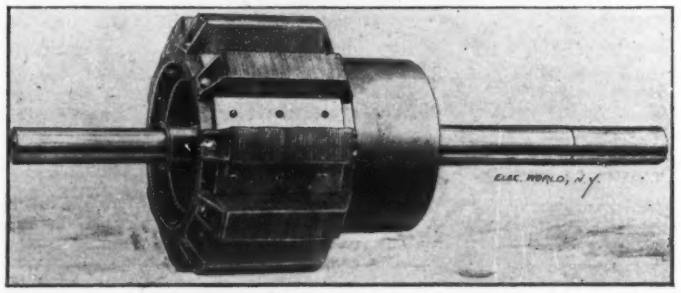
The armature coils are machine wound and of a plain oblong type, with easy corner bends. This simple form of coil reduces to a minimum the hazards of winding, for neither the structure of the wire nor its covering are subjected to the strains attendant upon the winding of complicated shapes with sharp bends, or of coils which are forced into place in the armature. These coils are thoroughly saturated with an insulating compound which has no affinity for the copper, but preserves the covering of the wire. For retaining the shape of the coil a single layer of untreated tape is wrapped all around and over this a thick coating of waterproofing compound is applied, which makes it practically impossible for moisture or oil to penetrate the insulation of the coil. Through all the processes of handling and treatment of coils, great care is exercised to prevent injury to the wire and its covering, and no compounds are applied which will deterioriate with age, or in any way attack the wire or covering. This is accomplished, too, without swaddling the coils in a thick or bulky envelope, which would interfere with a ready radiation of heat from the interior of the coils. The insulation of coils is mainly obtained from a special insulation trough which forms the interior lining of the coil slots in the armature. These troughs are semi-flexible, practically non-combustible, will not absorb moisture, are not affected by oil, and will not deteriorate with age. The troughs for 1000 and 2000 volt armatures are subjected to a break-down test of 6000 volts, and the troughs for high voltage armatures are subjected to a minimum of 15,000 volts break-down test. After the troughs and coils are in place in the armature an insulating perforated cover closes up the coil slot and secures the coils and troughs in position. The slot cover is perforated, which allows the revolving inductor to drive a continuous current of air around the coils. This produces such a cooling effect that these machines

Field Winding.

may be operated continuously under heavy overloads without serious heating of coils.

The field coil of the machine is of quite novel construction, for in effect it is simply a coil of wire suspended in air; that is, it has the insulation, the radiating surface and the free circulation of air around it, as if it were merely a coil of wire suspended in space in contact only with a number of insulating supports. The field coil case consists of two ring castings, spaced apart with rods of insulating material, and the sides lined at numerous places with narrow strips of insulating material. There is no floor in the case, and the sides are cut away except where backing is required for the insulating strips. The wire is wound over the insulating rods, and is in contact only with the rods and strips; it is a skeleton case, which leaves exposed the outer and inner circumferences of the coil, and practically both sides. The rotation of the inductor produces an agitation of air all around the field coil, with a constant circulation outward through the openings in the yoke, and the coil will stand severe overloads without injury.

The machines are handsome in design, of fine finish and incorporate the highest grade of workmanship. The efficiency is said to be equal to the best designs of direct-current generators, and the inherent regulation is claimed to be the best yet attained in alternators of any type. The placing of all the armature



The Inductor.

coils in a single wreath at one end of the machine, and the surrounding of every armature pole with an armature coil, produces better combined efficiency and regulation and a more correct form of current wave than any other construction. To these features the Warren-Medbery Company has united a robust and workmanlike construction, comprehending simplicity, accuracy and durability, forming a conjunction of desirable features and producing a most practical and reliable machine.

The electrical experience and high commercial standing of the stockholders of the Warren-Medbery Company form a guarantee of the ability and integrity of the concern to produce high-grade apparatus and to carry out its contracts.

The machines built by the company are designed by Mr. H. B. Warren, who has had large experience in this particular field.

Slow and Moderate Speed Motors of New Design.

In redesigning its line of motors to run at slow and moderate speeds the General Electric Company has adopted valuable improvements which experience with motors of former types and careful observation of their operation under actual commercial working conditions have proved advisable. The motors of the present type are, for their output, among the lightest and most compact built.

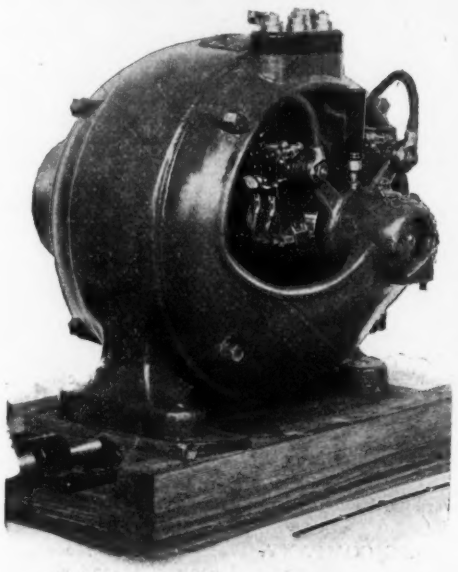
For all powers up to and including 5 horse-power in the slow speed and 8 horse-power in the moderate speed, the motors are bipolar; in larger motors up to and including 95 horse-power, four-pole construction is used. The latter method of construction has been adopted for large and moderate sized motors on account of its many manifest advantages, viz., shorter magnetic circuits, with consequent reduced exciting current; greater output and higher efficiency for given weight and speed; economical distribution of magnetic material and minimum of floor space.

The frames are of iron of the highest quality and the pole pieces of special soft steel. As the pole pieces are readily removable, the field coils may be taken off and changed without disturbing either the frame or armature. The frame is divided horizontally, and the upper part may be easily lifted off to permit access to the armature. The pillow blocks of the four-pole machines are cast with the bed plate and the lower part of the machine, thus insuring perfect centering of the armature. The bearings are all self-aligning, self-oiling and of ample size. The core is built up of laminations slotted to receive the armature coils which, lying below the outer surface of the core, are protected from mechanical strain or abrasion. The spider carrying the core is pro-

ELECTRIC LOCOMOTIVE "GEORGE WEST."

longed at each end in two flanges, upon which the ends of the coils lie without being bent. The armature is wound with the well-known G. E. barrel winding, which provides a large radiating surface for armature conductors, and reduces the length of wire to a minimum, thus reducing armature resistance losses and increasing the efficiency of the motor. The coils may be readily removed and replaced, and being embedded in the slots can neither move relatively to the core nor vibrate. When the armature turns air is drawn in to the ventilating ducts provided in the core and to circulate through the entire armature structure and reduce its temperature. The coils are made on forms and separately tested before assembling on the core. The insulation is the same as that used in the G. E. railway motors, and various tests have shown that it is tough, impervious to moisture and practically indestructible even under heavy overloads or by lightning. The commutator segments are of hard-drawn copper, supported on a separate spider, and the connections between them and the armature coils are carefully made to prevent the possibility of short circuiting.

The brush holders have a solid casting connecting the brush box with the stud and an adjustable pressure spring, giving an even pressure and firm and accurate contact of the carbon brushes and the commutator. Change from no load to overload can be made without changing the position of the brushes and without sparking. In the bipolar machines the projecting field effectually protects the spools and armature from injury. Stability is secured in these machines by so designing the heavy parts as to bring the centre of gravity very low. On account of the slow speeds of the four-pole motors they may be belted directly to ordinary slow speed line shafting without immediate countershafting. They are therefore, especially adapted to all factory, mill and shop requirements. The bipolar type is adapted to the driving of lathes, printing presses, fans, drills, pumps, and, indeed, to almost any work where small units of power are required and little space is available. They are arranged to run in any position, whether suspended from the ceiling, attached to a wall or set upon the floor.



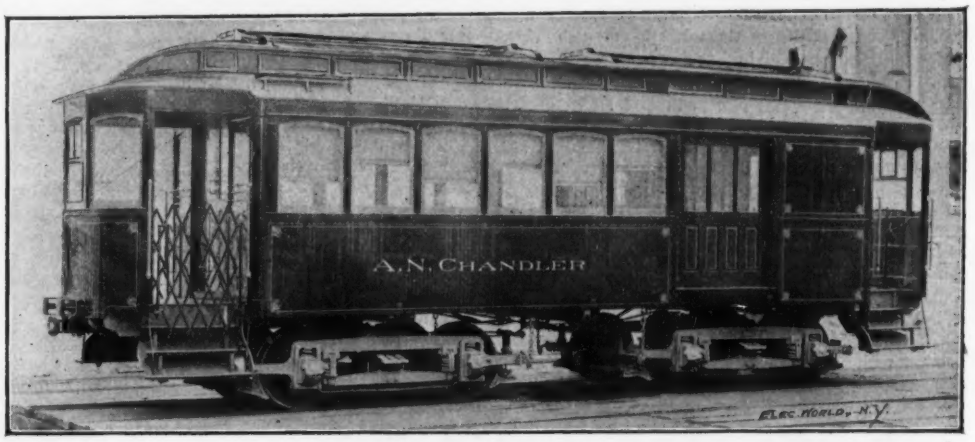
MODERATE SPEED BI-POLAR MOTOR.

A Pair of Electric Combination Locomotives.

The easy running of the "Perfect" truck built by the J. G. Brill Company, Philadelphia, the strength and stiffness of its framing and the fact that it is safe at the highest rates of speed have led to its adoption in a number of interesting cases when radical departures from ordinary railway practice appeared necessary or desirable. The accompanying illustrations show some of the recent novelties which have been possible by the use of this truck. Although they appear to be passenger coaches of unusual design, they are in reality electric locomotives intended to handle four loaded steam freight cars on a grade of 2½ per cent. They were built for the Ballston Terminal Electric Railway, Ballston Spa, N. Y., which was briefly described in THE ELECTRICAL WORLD of April 30, 1898.

One of these electric locomotives, the "George West," weighs 60,000 pounds, is equipped with four Westinghouse No. 38 motors, and has a hauling capacity of about 1600 tons on a level. The other locomotive, the "A. N. Chandler," weighs 34,500 pounds, and, according to steam locomotive practice, should be able to easily handle 800 tons on a level. It is also equipped with four Westinghouse motors.

The "George West" is 36 feet long over the end panels. The passenger compartment has five windows on each side, and is 14 feet 6 inches long, with a seating capacity of eighteen persons. The seats are longitudinal. The inside finish is of ash. The baggage compartment is 21 feet long. This part of the car is used as a smoker and is beside fitted with hinged seats, which are dropped when not in use. The platforms are 4 feet 6 inches long, and have round-end vestibules. They are closed by folding gates, and are provided with regular steam-car steps. The car is fitted with two 12-inch gongs and two Brill sand boxes. The roof of the car is plain and the platform hoods come flush with it. On account of the great length of the car body and because it is necessary to run in both directions a trolley board is fitted at each end, with a trolley pole on each. The smaller car, the "A. N. Chandler," differs from the "George West" in some of the details of construction. It has a full monitor roof brought down upon the platform hoods in the usual manner. The passenger compartment seats twenty-two persons, the smoking room and baggage compartment being but 9 feet in length. The body of the car is 25 feet long.



ELECTRIC LOCOMOTIVE "A. N. CHANDLER."

These cars are said to be as comfortable and convenient as could be desired for use on an interurban line. This general type may be used to advantage when a frequent train service is needed and when it is necessary to keep the expenses down to a minimum. Two men can operate a car or locomotive of this type, and when necessary attend to the train, whether of freight cars or trailers with passengers. These cars furnish all the conveniences and advantages of the ordinary steam train, and when frequent stops are made can, it is said, maintain a higher speed, with greater safety and economy.

It is stated that these locomotives form the first example of a mixed freight and passenger service ever operated with regular steam freight cars by electrical apparatus exclusively.

NEWS OF THE WEEK

Financial Intelligence.

THE EXPORTS OF ELECTRICAL APPARATUS during the past fiscal year, according to the "Boston News Bureau," were $3,054,453. The current year bids fair to exceed this, and there is no reason, the paper states, to believe that the war will in any way curtail the expected increase.

GENERAL ELECTRIC DIVIDENDS.—At the annual meeting of the stockholders of the General Electric Company, which was held at Schenectady, N. Y., on May 10, the following resolution was adopted: "Resolved, That the interests of the stockholders require that any proper or necessary adjustment of the impairment of the capital of the company should be promptly made with a view to early resumption of dividends."

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, May 16, 1898.

A 16,000 CP SEARCHLIGHT, which has been tested recently at Fort Hamilton, New York harbor, has been accepted by the Government. It will be used, it is said, for scanning the lower bay and harbor at night.

WEST INDIA CABLE INTERRUPTED.—The Western Union Telegraph Company last Saturday announced the interruption of the West India and Panama cable between St. Lucia and St. Vincent, in the West Indies. Communication by cable with Barbadoes, Grenada, Trinidad and British Guiana is cut off in consequence.

UNDERGROUND CONDUIT ROAD ON THE BOULEVARD.—It is reported that the Third Avenue Railroad Company is drawing plans to build an underground conduit road along the Boulevard, and that temporary power houses will be erected for the system. The policy of the company with regard to the Boulevard line has been much criticised. Three years ago it bought the old Boulevard street car line, and promised to give the West Side improved service. The old horse cars are still in use.

THE FRENCH LINE STEAMER "La Touraine," in passing out to sea on Saturday last, ran down off Sandy Hook a small boat containing eight members of the corps of engineers engaged in replacing observation mines. All the men were thrown into the water, and two of them, both electricians, were drowned. The names of the unfortunate men were Victor Passa and Robert Middleton. Passa lived in Brooklyn, and Middleton, who was an employee of the General Electric Company, resided in Orange, N. J.

MEETING OF THE NEW YORK ELECTRICAL SOCIETY.—The 187th meeting of the New York Electrical Society was held in the concert hall of Madison Square Garden on Thursday evening, May 12, the members of the society and their friends being admitted to the Garden, where the electrical show is being held, at one-half the usual rate. A paper was read by Dr. Schuyler S. Wheeler on "Electrically Driven Machinery," and was fully illustrated by lantern slides and some experiments. The paper was quite popular in its character and was intended for the non-technical hearer, the treatment being largely historical and descriptive.

THE QUESTION OF CAR TOLLS ON THE BRIDGE.—Commissioner of Bridges Shea on May 10 met representatives of the elevated roads in Brooklyn, and submitted the proposition that if the bridge railroad is run in connection with the elevated systems the latter must pay 45 cents a car for each 1600 cars a day as a minimum, and $12,153.44 for rent of terminals and repairs, making a total charge of $274,593.44 a year. If the bridge system is leased to the elevated roads, then they must pay 10 cents for each of the 2500 cars a day and $20,306.28 for terminals, making $111,556,28 a year. The representatives took no action on the proposition. Under the agreement made with the old bridge trustees the elevated roads were to be charged 12½ cents for each car crossing the bridge. It is stated that the trolley companies are not disposed to accept Commissioner Shea's terms, and that they will contest the matter in the courts. It is understood that the elevated roads will also refuse to accept the propositions. Commissioner Shea, it is stated, will ask the courts to annul the contracts with the trolley and elevated roads if these roads refuse to pay enough to defray the bridge expenses.

TELEGRAPH TOURNAMENT.—On the afternoon and evening of May 14 the National Morse Telegraph Tournament, announced in previous issues of THE ELECTRICAL WORLD, took place in the concert hall at Madison Square Garden. The affair was a great success, and much enthusiasm prevailed among the large number of telegraphers from various cities who were in attendance. The afternoon session began at 2 o'clock, and the first contest set down on the programme was the ladies' class, sending five minutes; first prize, $80; second prize, $60. There were 10 entries. The successful contestants were Miss J. McManus, first, and Miss Emma R. Vanselow, second. Miss McManus' record was 239 words, 8 errors and superior Morse; Miss Vanselow's 241 words, 8 errors, good Morse. For the 230-word class, sending five minutes, there were 7 entries. The first prize ($90) was won by Chas. F. Edney, whose record was 233 words, 1 error, and excellent Morse. The second prize ($70) went to F. M. McClintic, with a record of 242 words, 5 errors and good Morse. The third and last afternoon contest was the 240-word class, sending five minutes; first prize, $100; second prize, $75. There were 6 entries. The first prize was won by J. D. Hinnant, who made a record of 252 words, 4 errors, and good Morse; the second prize was taken by F. M. Clintic, who sent 243 words, good Morse, making 3 errors. The evening session was largely attended by friends of the contestants and others engaged in the various branches of the electrical industry. The first contest was the message receiving class, fifty messages being transmitted by F. L. Catlin, each receiver copying the messages directly on a typewriter. Every make of typewriter was represented, and the rapidity with which these machines were operated and the message blanks changed was quite remarkable. The first prize in this class was $100, and the second $75. There were 19 entries. Decisions in this class will not be rendered until the judges have carefully examined the work of the contestants. For the code class, sending five minutes, there were 5 entries. The prizes were $100 first, and $75 second. Mr. G. W. Conkling won the first prize, with 345 words and 2 errors to his credit; W. M. Gibson second, with 330 words and 2 errors. The next event was for the championship, sending five minutes. The prizes offered to the two leading contestants were $100 to the first and $75 to the second. There were 7 entries. W. M. Gibson took the first prize, sending 254 words, perfect Morse, making 1 error. The second prize went to F. L. Catlin, who sent 253½ words of perfect Morse, making 1 error. The final contest was for the receiving championship, in which there were 16 entries. The prizes were the same as those in the last preceding contest. The decision in this contest will be announced after the judges have examined the work of the contestants. Mr. Fred Catlin, the manager of the tournament, conducted the affair with masterly skill, and it passed off very smoothly. To enable the audience to clearly hear the clicking of the receiving instruments a very ingenious arrangement was devised by Mr. T. J. Smith. At the small end, or the mouthpiece, of two megaphones were fixed a sounder properly connected with the general circuit. The megaphones, which were turned toward the audience amplified the sound of the instrument to so great an extent that telegraphers in any part of the hall could read and follow the transmitted matter very clearly and distinctly. Phonetic records of all the senders in the championship and code classes were successfully made by the Manufacturers and Inventors Electric Company. Mr. Thomas A. Edison and Hon. J. D. Reid were interested attendants at the evening contests.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., May 14 1898.

MR. NORMAN MARSHALL, treasurer and general manager of the Anchor Electric Company, Boston, has been for a number of years a member of the Massachusetts Naval Reserve in Boston harbor, and at present occupies the honorable position of chief of the torpedo division. While Mr. Marshall is obliged to give considerable attention to his new duties he manages nevertheless to devote sufficient time to his company in directing the exacting details of its business, and will, he says, present very soon to the trade some new specialties.

MR. H. H. BROOKS, of the American Circular Loom Company, Boston, whose acquaintance and popularity in the electrical business is extensive, has returned from a several months' trip to New Mexico thoroughly recuperated in health. At his desk a few days ago he looked precisely "as of old," full of buoyancy and conservative optimism regarding business. Altogether there is not a happier or harder working trio in the electrical business than Brooks, Clark and Wilson, of this well-known and progressive company, and what they miss in the business the other fellow is perfectly welcome to.

MR. H. A. HOWARD, until recently for over ten years Boston agent of the C & C Electric Company, having resigned his position with that company, has accepted the agency of the Elwell-Parker Electric Company of America, continuing at his old location, 63 Oliver Street, Boston. Mr. Howard built up a large business in Boston and vicinity for the C & C Company, whose officials express most kindly testimony as to his successful efforts and abilities. The Elwell-Parker Company is to be congratulated on securing his valuable services, and so is Mr. Howard on having secured such an excellent company for representation.

THE COLUMBIA ELECTRIC COMPANY, Worcester, Mass., continues to do a nice business in electrical engineering and contracting and electrical supplies. It has also for several years had the exclusive agency of the C & C electrical apparatus. The Stevens Block, Lowell Building, Fire Department Headquarters and Norton Emery Wheel Company, all of Worcster, are some of its most prominent and recent installations. The company does a good telephone business, and is introducing an intercommunicating system of its own make in connection with the Swedish transmitter. The officers of the company are: President, Charles W. Gilbert, of the Gilbert Loom Works; treasurer, Frank E. Gilbert, and manager, Henry D. Temple. Mr. E. W. Howard is also associated in its management, and all of its officers are active and wideawake in business.

THE PAGE ELECTRIC COMPANY, Worcester, Mass., is unusually active, and has just closed a successful financial year. This house is, as is well known, the oldest electrical house in Worcester, and one of the oldest in New England. It was established in 1885, and was incorporated in 1897. It has installed electric work in a large number of residences during the past season, and has just completed the electric work in the residence of Mr. W. J. Hogg, which was a very elaborate affair, iron conduit and a large number of combinations

and electrical contrivances being employed. Among some of the contracts which the company now has on hand are the electric wiring for the new summer residence of Mr. George F. Blake, Jr., and the electric work for the new high school at Gardner, Mass., the wiring of which is being installed in iron conduit.

THE CENTRAL ELECTRIC COMPANY, Worcester, Mass., John P. Coghlin, manager, is very busy for this time of the year. Nelson's new theatre at Springfield, which opened recently, was one of its creditable installaaions, some 1600 incandescents being used, also several enclosed arc lamps. The current is taken from an isolated plant run in connection with the theatre. There was not a hitch in the lighting at the opening performance, which speaks well for the quality of the work. This company is also just completing a large electric contract in New London, Conn., in connection with the changes which are taking place at the Mohican, owned by Mr. Frank A. Munsey. This is a fireproof building, and the wiring is consequently in iron conduit. This company, under its energetic manager, has installed during the past season a large number of isolated plants, etc.

THE ELECTRIC POTENTIAL held its annual meeting at Young's Hotel Tuesday evening, May 10. Five new members were voted in and the old board of officers chosen, as follows: President, Edmund H. Hewins; vice-presidents, H. H. Fairbanks and William Brophy; treasurer, I. H. Farnham, and secretary, Sidney Hosmer. After partaking of a bountiful dinner Mr. George B. Francis, civil engineer of the Boston Terminal Company, and Mr. Henry J. Conant, of Westinghouse, Church, Kerr & Co., entertained the gathering with interesting remarks on the new Southern Terminal Station and the large power plant being installed in connection therewith. Mr. Francis began by giving a few facts upon the great extent of this undertaking. The Terminal Company has already driven 25,000 piles, and expects to drive 15,000 more. There are at work on the immediate ground about 1400 men, using sixty-five engines and nearly as many derricks, but only two electric motors. The question had arisen as to whether or not it would be cheaper to concentrate this steam power and use electric motors in connection with the various derricks, pumps, etc. The train shed proper will have twenty-eight tracks, while the loop or subway will have two tracks. This loop will nearly double the capacity for handling passengers. Being some 6 feet below high water mark it has been made waterproof first by heavy concrete on piling, then a thin layer of coal tar pitch, another of concrete, making a thickness of from 3 to 4 feet, according to conditions. Mr. Francis touched briefly on the power plant, the gas plant, ice plant, and the method of handling baggage. These were further explained by Mr. Conant, of Westinghouse, Church, Kerr & Co. In speaking of the system of levers for switching trains, Mr. Francis stated that there was a station in London having 182, and if the same method were used here 452 would be required. By the use of electricity the number is reduced to 172. Thus was solved a difficult problem here as well as at the Northern Station. Mr. Francis presented each member present with a diagram some 20 inches square, showing in perspective the station looking from Summer Street, a section of the roof, the loop or subway and the tracks in the main shed. Mr. Conant explained some of the difficulties to be overcome in the installation of the electrical equipment. The Westinghouse Electric Company's system is used. The power house is 450 feet long by only 45 feet wide, thus necessitating placing a great deal of apparatus in tandem. Here will be located dynamos for the electric lighting, generators for electric elevators, apparatus for the making of from 20 to 25 tons of ice every twenty-four hours, the ventilation of offices, waiting rooms, etc., and for filtering and cooling all the drinking water. Dynamos will be direct current coupled to Westinghouse compound engines. Electric elevators or lifts will be used for moving baggage from the basement to the main floor of the train shed. These elevators must not go down into the waterproofing of the subway or above the tracks of the main shed, conditions that practically barred the various hydraulic elevators. Again, the long distances from the source of power at which they must be placed made the hydraulic system an enormously expensive affair. By the use of electrically driven pumps the large amount of surface water from the train sheds, etc., will be kept from the subway. The heating and ventilating of not only the large waiting rooms, but the offices, will be accomplished by a system of electric fans. The Pintsch gas plant will furnish gas for the lighting of the numerous trains, while to light the mammoth structure there will be required some 300 arc and 7000 incandescent lamps. After listening to these interesting remarks by Messrs. Francis and Conant the members of the Potential had a much clearer idea of this undertaking, by far the largest in the world. Work is progressing rapidly in every department of construction, and many of the most difficult problems have been solved. It is expected that trains will be run from the station some time in December of this year.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., May 14, 1898.

THE REMOVAL of the Westinghouse Company's office to Ellicott Square, which is just taking place, brings most all of the leading electrical people of the city together. These include the Westinghouse, the General Electric, the Walker Company, the Crocker-Wheeler Electric Company, and also Engineers Horatio A. Foster and the Ricker Brothers, all, or nearly all, of whom are on the sixth and seventh floors of the building.

IT IS STATED semi-officially that the power for the western half of the new trolley line which is to run on the old Erie tracks from Tonawanda to Lockport will be furnished from the Niagara tunnel through the transformer and other machinery to be put in at Tonawanda. It is expected that the Ely line power house in Tonawanda will be made a sub-station of the Niagara Falls and Buffalo line. This will speedily revolutionize the power situation in that vicinity, and make Tonawanda a centre of distribution in two directions. As the Lockport city trolleys are to be a part of the new system a steam plant will be used at that end of the new line instead of drawing from the tunnel.

FOUR 500-KW STEP-DOWN TRANSFORMERS and two 500-hp rotaries are being installed in Tonawanda for the use of the Ely trolley line between Tonawanda and Buffalo. This north half of the Ely line to the Falls has always been operated by the steam plant in Tonawanda, as the capacity of the cables of the road has never been sufficient to handle the current all the way from the Niagara tunnel. Only the northern half of the road has therefore been run by current from the Falls. Though the new electrical apparatus in preparation for Tonawanda is mainly intended for the use of the Ely trolley line it is the intention to have a supply ready for private use also. Several enterprising corporations were wise enough to obtain an agreement from the tunnel company to supply the current at 10 per cent. less than the Buffalo price. Among the concerns in Tonawanda that is preparing for electric power is the McDonald flour mill of 250 barrels capacity, which is being rebuilt.

SOUTHERN NOTE.

WASHINGTON, D. C., May 14, 1897.

THE NAVAL APPROPRIATION BILL makes provisions for various electric light plants, electrical improvements, etc., as follows: For addition to the electric light system at the Brooklyn Navy Yard, $15,000; for heating purposes and electric light plant at the League Island Navy Yard, $5,500; for the improvement of the lighting plant at the Washington Navy Yard, $16,000; for the enlargement of the electric plant at the Norfolk Navy Yard, $20,000; for an electric light and power plant at the Port Royal naval station, $20,000; for the extension of the electric system of the Mare Island Navy Yard, $15,000; for an electric light plant at the Puget Sound naval station, $9,800, and for the installation of electric plants in the gunboats numbered 10, 11, 12 and 13, $40,000. An appropriation for $21,000 is made for the office of the Chief Signal Officer for the purchase, equipment and repair of field electric telegraphs, signal equipments, telephone apparatus and the maintenance of military telegraph lines and cables, etc. An appropriation of $23,225 is proposed for a portable electric outfit for the engineer department.

PITTSBURG NOTES.

PITTSBURG, Pa., May 12, 1898.

DIVIDEND DECLARED.—The Citizens Traction Company has declared a semi-annual dividend of $1.50 per share, payable on May 16, to stockholders of record on May 10.

CONSOLIDATED TRACTION COMPANY CHANGES.—The completion of the Penn Avenue bridge across the Pennsylvania Railroad tracks at East Liberty has enabled the Consolidated Traction Company to resume the operation of through cars on Penn Avenue, between the city and Wilkinsburg. During the reconstruction of this bridge an annoying transfer was necessary at that point. The Highland Avenue bridge has also been completed, and for the first time in many months cars are now running on South Highland Avenue. A new line of cars has been established, running from East Liberty to the city by way of South Highland and Fifth Avenues. The big car barns at Homewood are rapidly approaching completion, and when finished will afford ample storage capacity for the company's rolling stock.

FRANCHISE FOR THE MONONGAHELA STREET RAILWAY COMPANY.—The ordinance granting rights of way to the Monongahela Street Railway Company has been passed by both branches of Council. The route granted is from Brown's bridge over the Monongahela River to the Schenley Park bridge, over Junction Hollow, and traverses Hazlewood Avenue, Murray Avenue, Forbes Street, Woodlawn Avenue and Joncaire Street. It is understood that a portion of the route now traversed by the Homestead and Highlands road will be abandoned, and that the new road will take its place. The ordinance gives the company the right to lease its line. President C. L. Magee, of the Consolidated Traction Company, attended the Council meeting and urged the passing of the ordinance. He stated that a running arrangement would be made with the Consolidated Company, so that residents of the district covered by the new road would be enabled to travel to and from the city for a single fare. Opposition was made to the measure on the ground that it did not provide for an adequate return to the city for the privileges granted; but it finally passed by a considerable majority in both branches.

CHICAGO NOTE.

Branch Office of THE ELECTRICAL WORLD
936 Monadnock Building.
CHICAGO, Ill., May 14, 1898.

THE CHICAGO ELECTRICAL ASSOCIATION recently sent out circulars to electrical engineers and others containing information regarding enlistment in the United States brigade of engineers. The committee appointed by the Chicago Electrical Association to confer with Mr. B. E. Sunny, who is Capt. Eugene Griffin's local correspondent, thinks that the association offers an excellent means through which to reach the desired parties, and it therefore addressed the circular letter to its members and friends with the request that they make known its contents to all of their associates with whom they come in contact. Captain Griffin is engaged, as is well known, in the work of raising the brigade from the nation at large, and with Mr. Sunny to aid him at this point Chicago will no doubt make a good showing.

ST. LOUIS NOTES.

ST. LOUIS, Mo., May 14, 1898.

A MOTION has been made asking that the receivership of the Peoples Railway Company be vacated and the property be restored to the company's officers. The motion will be argued on May 13.

ST. LOUIS BIDS fair to become one of the greatest long-distance telephone centres in the country. The construction of two separate and distinct lines has been commenced by the American Telephone and Telegraph Company.

Kansas City and Memphis are to be brought into direct telephone connection with this city, and the stringing of nearly 500 miles of wire is now under way.

CEMETERIES' LINES.—Property owners on the proposed extension to the cemeteries of the Suburban and Meramec River lines appeared before the Council railroad committee last week in support of the bills. The committee postponed its report in order to consider further the provisions providing compensation for the city and for hauling freight.

Pacific Coast Notes.

San Francisco, Cal., May 7, 1898.

THE PALMO POWER & WATER COMPANY, of San Diego, Cal., was recently incorporated with a capitalization of $1,250,000, all subscribed. The directorate includes George F. Coats and William G. Talbot, of Los Angeles, Cal., and George D. Tatau, James P. Jones, W. S. Hebbard, of San Diego.

THE CALIFORNIA AUTOMATIC TELEPHONE COMPANY, of San Francisco, has its apparatus on view at its office, 206 Sansome Street. The manager, Mr. Gore, claims that one girl can operate three panels, each connecting with ninety subscribers. William F. Smith is the secretary. A factory will probably be established at the East.

THE SAN FRANCISCO "EXAMINER'S" complete independent electric power plant is now finished and ready for operation. There are six Bullock direct-current generators, directly connected to Wright Automatic engines. The three large Hoe presses are driven by Bullock slow-speed motors. A large electric sign adorns the top of the building, surmounting an electric bulletin board of the type used by the New York "Journal." The bulletin board contains 524 incandescent lamps of 220 volts. The wiring of the building was done by Wybro & Lawrence, iron armored conduit being used throughout. The lighting arrangements are complete and artistic. Mr. Vining, formerly of the Brooklyn Navy Yard, superintended the installation of the power plant. There are two Sprague electric elevators, of the tandem worm type. A number of Arnold flexible electric brackets are used in the building. Spectators' galleries are arranged so that the various departments of the paper can be viewed while work is going on.

Canadian Notes.

Ottawa, Ont., May 14, 1898.

IT IS PROPOSED to build an electric railway between La Patrie and Scotstown, in the province of Quebec.

THE TOWN OF LINDSAY, Ont., is to have a new electric light company. The water power to operate the company's plant is to be supplied from the village of Fenelon Falls, which is 16 miles distant from the town.

THE MONTREAL STREET RAILWAY COMPANY has just had printed 15,000,000 car tickets, the cost of printing being $1,100. The company is said to have received the large sum of $3000 for the advertisements printed on the tickets.

MR. MARK ESCHWEGE, of Vancouver, B. C., representing the Anglo-French Telegraph Company, has received a cable message ordering him to commence a survey at once for a cable from Vancouver to Dyea, Skaguay and Wrangel. The head office will be at Vancouver, and there will be offices at Victoria, Dyea, Skaguay, Wrangel, and Dawson. The cable is now being manufactured in Europe.

THE REPRESENTATIVES of the Toronto City Council visited Niagara Falls for the purpose of inspecting the electric power works which have been established on the American side by the Niagara Power Company. Questioned regarding the possibilities of transmitting power to Toronto, Mr. W. B. Rankine, manager of the company, stated that the loss in transmission to Buffalo was 12½ per cent., and a further loss of 6 per cent. was incurred in distribution in the city. What the loss would be in the longer distance to Toronto he did not know, but the electrician of the company estimated that it would be at least 25 per cent.

THE DOMINION GOVERNMENT has decided to remove the meteorological observatory from Queen's Park, Toronto, owing to the disturbance of the street railway currents in that city, to Agincourt, some miles distant, where the work of the institution can be effectively carried on. The building to be erected there will consist of a circular stone underground chamber of some 30 feet in diameter, topped by a brick structure for the making of absolute determinations. The utmost care will be exercised in its erection, and every stone put into its walls will be tested to ascertain that it contains no iron matter to disturb the delicate working of the magnetic instruments within.

MR. PETER TRUDEAU, of Ottawa, inventor of the electric heater controlled by the Dominion Electric Heating & Supply Company, of this city, visited Philadelphia recently to give an exhibition of the capacity of his heater. Mr. Hewitt, engineer of the Union Traction Company, of that city, conducted the tests as against the best heaters now in use in the United States. Mr. Hewitt's official report, just received, declares that the results indicate that the Ottawa heater is the most economical in the use of electrical energy at the temperature maintained. The only question to be settled to determine the sale of the right to manufacture the Ottawa invention in the United States for a considerable sum of money, is the durability of the heater. The heaters have now been in use for two years in the Lachine power house, and show no signs of weakness.

French Notes.

(From Our Own Correspondent.)

Paris, April 14, 1898.

FRENCH PHYSICAL SOCIETY.—In the afternoon of Saturday, April 15, papers will be read by some of those who have been in the habit of exhibiting every year before the Physical Society. The following is a list of the papers and their authors: M. Ducretet, on Hertz telegraphy without wires, with M. Branley's receiver and M. Ducretet's transmitter; M. Morin, on the relation between the magnetization of magnetic needles and their length—an essay on the theory of magnetic distribution; M. Hurmuzescu, on the nature of the metal during the absorption and emission of X-rays. On Thursday, April 14, the guests of the society visited the new station of the Compressed Air Company of Paris, which lights one of the divisions of the city. Among the exhibitors are to be noticed: M. Bardon, arc lamps; M. Blondel, the Blondel-Carpenter hysteresis meter; M. Borretti, station machine for radiography; M. Bonty, new method for measuring the strength of magnetic fields; M. Broca, some properties of electrical discharges in a magnetic field; M. Camicel, a thermo-mercurial ammeter and a thermo-calorific voltmeter for use with alternating currents; French Electric Construction Company, rectifiers; Contremoulins, apparatus for the discovery of projectiles buried in the skull; V. Cremieu, a new interrupter for induction coils; Diorin, accumulators for autocarriages and the production of X-rays; Doignon, apparatus for determining the correction of compass; Ducretet, radiographic apparatus; Forneau de Courmelles, ozonizers; Gugenot, new experiment in electromagnetism; Taubert, the micro-phonographs of Berthon, Dussaud and Joubert; Lamotte, M. Deude's apparatus for the study of electric wave absorption; Margot, interrupter for induction coils; Pellin, mercury arc lamp; Rochefort, the Wydst-Rochefort transformer; Electric Light Society, rotary converter of 2500 watts capacity for transforming alternating current of 110 volts pressure to direct current of 140 volts pressure and 18 amperes, 40 periods, 1200 r. p. m.; Tommasi, electrolyzer for separating the silver from argentiferous lead; Weiss, electromagnet for setting up a field of 30,000 units, built for the faculty of sciences at Rennes. This collection of exhibits embraced about everything new that has been done in France during the past year. These annual exhibitions are usually extremely successful.

THE ALEXANDER III. BRIDGE.—The cornerstone of the Alexander III. Bridge was laid in October, 1891, on the occasion of the Czar's visit to Paris. This bridge is intended for use in connection with the exposition in 1900, and lies between the Esplanade des Invalides and the Champs Elysées; it will unite the two parts of the exposition, which will be on either side of the River Seine. The work is already sufficiently advanced to convey an idea of the magnificent size of this bridge, the width of which will be fully 100 metres (330 feet). Sightseers are already beginning to visit the exhibition grounds, where the work is in progress, and everyone is greatly struck by the energy with which it is being pushed in every direction. Among the many participators in this gigantic enterprise is the O. Patin Electrical Company, which has made a considerable reputation in the high potential alternating current field, and is now meeting with equal success in the manufacture of direct current apparatus. It has, indeed, installed quite a large number of plants in a very short time, and among them is the one that is being used in connection with the erection of the Alexander III. Bridge. For the purpose of lighting the caissons and transmitting power to the various machines, such as pumps, mixers, etc., the O. Patin Electrical Company first put in a plant on the right bank of the river, removing it after the completion of the first caisson to the opposite side, for use in the erection of the second one. Having very little space at its disposal only a very small shed could be put up, in which, however, it was able to shelter a boiler, two engines and two generators. The boiler is on the Roser system, multitubular, having 40 square metres (448 square feet) of heating surface; it has been operated continuously day and night for several months without stop, and has given absolute satisfaction. The two generating sets are remarkable for compactness. The engines which, it seems, are soon to be built in France as well as in England, are vertical high-speed engines, made by Raworth. This is the first instance of the installation of one of these rather remarkable machines in France. What distinguishes it chiefly from other types of high-speed engines is the method of steam distribution. The two cylinders are arranged one above the other, and are separated by an intermediate receiver. Both the high and low pressure valves are of the Corliss type, and are placed between these cylinders. The small piston is at the top of the engine. High pressure steam acts under this piston, and the expanded steam acts on the top of the large piston. Upon reaching the end of its upward stroke the small piston passes a row of holes, drilled near the top of the cylinder, through which the pressures in the cylinder and receiver equalize, the volume of the receiver being such that there will be only a slight difference between the pressure in it and that in the cylinder. The exhaust from the small cylinder expands in the large one as the piston goes down, until the admission valve closes. Part then passes into the receiver and a very small portion remains to form a cushion. Any water in the small cylinder passes into the large cylinder, whence it escapes into an exhaust chamber through holes around the entire circumference of the cylinder when the piston has reached the end of its downward stroke. Each of the engines used at the Alexander III. Bridge is of 25 horse-power at 500 r. p. m. The generator is of the Patin direct current type, direct connected. Both machines are mounted on an iron frame of great rigidity. The generator is a four-pole machine, shunt wound. The voltage is about 170. The field is octagonal in shape, and made in two parts, one-half being cast with the bed plate. The poles are of steel and are bolted on radially to the frame; the bed plate is a single piece, carrying at the ends the supports for the bearings. The latter are readily taken down, being made in two parts. Lubrication is obtained by means of rings turning freely on the shaft and hanging in oil, which they spread on the journals and shaft. The bearings are very long. The armature is made of laminations carefully insulated, and is drum wound. The brushes, four in number, are of carbon, with six pieces to each set; contact is obtained by a brush-holder of very simple and effective design. The machine has a very high output, and is designed to run from no load to full load without drop in voltage. Some trouble was encountered with the distribution of the light in connection with this plant, from the fact that the light was needed for caissons, that is, at the bottom of the Seine. As the result of the great care bestowed on the smallest details, however, no accident occurred. The lighting is done with 160 16-cp incandescent lights for the caissons. In the yards and shops there are about twenty 50-cp lamps and four 300-cp lamps; they are connected in groups of two in series. The various machines in the yards are driven by series motors of the O. Patin Company's design, and ranging from 3 to 7 horse-power.

General News.

NEW INCORPORATIONS.

THE PEOPLES TRAMWAY COMPANY, Putnam, Conn., has been incorporated with a capital stock of $125,000.

THE SEYMOUR STREET RAILWAY COMPANY, Winton, Pa., has been formed with a capital stock of $30,000.

THE E. A. PERKINS ELECTRIC COMPANY, Torrington, Conn., has been incorporated with a capital stock of $5,000.

THE MORROW COUNTY TELEPHONE COMPANY has been organized at Mount Gilead, Ohio, with a capital stock of $12,000.

THE HOGAN ELECTRIC COMPANY has been incorporated at Charleston, W. Va., with a capital stock limited to $100,000.

THE ALLENTOWN & KUTZTOWN TRACTION COMPANY, Allentown, Pa., has been organized with a capital stock of $10,000.

THE MOUNTAIN STATE TELEPHONE & TELEGRAPH COMPANY has been formed at Charleston, W. Va., with a capital stock of $50,000.

THE COXSACKIE ELECTRIC LIGHT AND POWER COMPANY has been incorporated at Albany, N. Y., with a capital stock of $20,000. The Messrs. Newbury are the incorporators.

THE BILOXI STREET RAILROAD COMPANY has been incorporated at Jackson, Miss., with a capital stock of $7,500. The incorporators are C. C. Daniels and J. J. Bradford.

THE STURGIS MOTOR VEHICLE COMPANY, Los Angeles, Cal., has been formed with a capital stock of $1,000,000. The directors are A. Solano, S. D. Sturgis and Charles McFarland.

THE BARNESBORO ELECTRIC LIGHT COMPANY, Pittsburg, Pa., has been formed with a capital stock of $1.000. The directors are Thomas Barnes, George W. Ziegler and others.

THE ROUSSEAU ELECTRICAL WORKS, New York City, N. Y., has been formed with a capital stock of $25,000. The directors are John S. Douglas, David Rousseau, C. H. Hart and others.

THE STANDARD TELEPHONE COMPANY, Newtown, Pa., has been formed with a capital stock of $10,000. The directors are Harrison Worstall, Watson Church, George Hicks and Harry Smith.

THE TRI-STATE TELEPHONE COMPANY, Kansas City, Mo., has been incorporated with a capital stock of $200,000. The incorporators are E. G. Phelps, C. H. Francis, James M. Girder and others.

THE JANSEN-KILL POWER COMPANY, Hudson, Columbia County, N. Y., has been incorporated with a capital stock of $100,000. The incorporators are William A. Harder, Jr., Philip M. Harder, Charles N. Harder.

THE PACIFIC LIGHTING COMPANY, San Francisco, Cal., has been formed, with a capital stock of $50,000. The directors of the company are J. M. Livingston, C. B. Miller, H. W. A. Miller, W. B. Cline and Joseph Hutchinson.

THE HAMILTON TELEPHONE COMPANY, Hamilton, Ohio, has been formed with a capital stock of $25,000. Among those interested are James E. Hancock, Eugene Hughes, Samuel D. Fitton, Jr., George Hutchinson and Ed. J. Shroder.

THE MAGNETIC ELECTRIC LIGHT & POWER COMPANY, Memphis, Tenn. has been incorporated. The incorporators are M. E. Carter, F. W. Brode, B. M. Stratton, W. C. Bridges and H. F. Robinson. The capital stock is $10,000,000.

THE INTERURBAN RAILWAY COMPANY, Valley Junction, Ia., has been incorporated, with a capital stock of $50,000. The incorporators are M. H. Polk, J. B. Jones and others. The purpose of the company is to construct a street car line between Valley Junction and Greenwood Park.

THE BUFFALO & LOCKPORT RAILWAY COMPANY has been incorporated at Albany, N. Y., for the purpose of operating a street surface road from Buffalo to Lockport. The directors are Burt Van Horn, H. J. Pierce, R. L. Fryer, and G. H. Dunbar, of Buffalo; J. A. Merritt, S. Curt Lewis and F. M. Ashley, of Lockport; F. A. Dudley and W. Caryl Ely, of Niagara Falls. Capital stock, $1,000,000.

THE TELEGRAPH AND TELEPHONE.

IMLAY CITY, MICH.—The Village Council has granted a thirty-year franchise to the New State Telephone Company.

KANKAKEE, ILL.—The East Illinois Telephone Company, of Kankakee, has certified to an increase of capital stock from $15,000 to $25,000.

JERSEY CITY, N. J.—The New York & New Jersey Telephone Company has established a station at the State Camp at Sea Girt, which gives direct communication with New Jersey's volunteers.

LIBERTY, N. Y.—The Liberty Telephone Company has sold its franchise, poles, wires and all its property, except the central station switchboard, to the Delaware River Telephone Company, for $1,000.

ANDERSON, IND.—The new long-distance telephone company of Indianapolis will build a toll line through Anderson from Indianapolis to Muncie and Fort Wayne. It is stated that these toll lines will connect every city in Indiana.

GALVA, ILL.—The Central Union Telephone Company has absorbed the Tom A. Marshall Telephone Company, operating in Mercer and adjoining counties, and will immediately equip it with a metallic circuit. The line will soon be extended to Galva.

HARRISBURG, PA.—Ten thousand shares of the Drawbaugh Telephone & Electrical Appliance Company's stock have been sold at trustee's sale to Daniel Drawbaugh, the prime mover in the company, at his bid of $11,600. It is stated that Mr. Drawbaugh is at work on a device which he claims will be valuable in warfare and mining.

WASHINGTON, D. C.—Through the Bureau of the American Republic it is learned that the Mexican Government has contracted with the Mexican Telegraph Company for the International service, to be effected through the lines of that company and those of the Western Union of the United States. The Mexican Telegraphic Company binds itself to pay the Government of Mexico 15 per cent. of the annual profits, guaranteeing that the 15 per cent. shall be no less than $20,000 gold per annum.

ELECTRIC LIGHT AND POWER.

PITTSTON, PA.—The Wilkesbarre Electric Light Company will build a sub-station on the Dickson Manufacturing Company's plot.

HOLLIDAYSBURG, PA.—The Council has passed an ordinance taxing all poles carrying electric wires $1 when located in the public streets, but only 75 cents if in the alleys.

WILMINGTON, N. C.—The contract for lighting the streets with electricity has been awarded to the Wilmington Street Railroad Company at $7 per month per arc light of 2000 candle power, moonlight schedule.

ST. LOUIS, MO.—The Decatur (Ill.) Gas & Electric Company and the Municipal Electric Light Company have consolidated under the name of the former company. The capital is $400,000. Peoria and Decatur capitalists own the property.

PITTSFIELD, MASS.—The Pittsfield Electric Company has been granted permission by the State authorities to issue $25,000 additional stock and $100,000 of bonds. The bonds are to be of the 5 per cent., ten-year kind, and $75,000 will be issued for the purpose of taking up additional bonds.

CLAYTON, MO.—The Ferguson electric light plant was recently turned over to its new owner, Mrs. King, who operates several plants in Illinois and understands the business thoroughly. She promises to make many needed improvements and will endeavor to give her patrons entire satisfaction.

WASHINGTON, D. C.—The proposal at Alexandria, Va., to sell out the electric light plant for $150,000 and light the city from the Potomac Electric Power Company, of Washington, D. C., has created much comment. The latter company promises much lower prices. The city has been losing money steadily by operating its own plant.

THE ELECTRIC RAILWAY.

ALBANY, N. Y.—The Coxsackie & Middleburg Electric Railroad Company has commenced the construction of the line. The first 5 miles must be finished by July 1.

WASHINGTON, D. C.—The Capitol Traction Company has begun the operation of its Pennsylvania Avenue and Fourteenth Street lines by current from the new power house of the company.

NEWARK, N. J.—The Newark & South Orange, N. J., Street Railway has rejected the ordinance granting it a franchise in Newark. One of the requirements was that passengers should be carried from Newark through to New York for 10 cents.

BROOKLYN, N. Y.—President Rossiter, of the Brooklyn Heights Railroad, says that the Montague Street cable road will not be changed to an underground electric road till next fall.

ALBANY, N. Y.—Attorney-General Hancock has granted the application of the minority stockholders of the Kings County Traction Company, of Brooklyn, for permission to bring an action to dissolve the corporation and secure the appointment of a receiver to wind up its affairs.

COHOES, N. Y.—The highway commission of Waterford has granted a franchise to the Mechanicville & Stillwater Railway Company to lay tracks in town under these conditions: The company to use girder rail, to pave between rails and two feet each side and pay $2500 for the privilege.

BUFFALO, N. Y.—An alderman has introduced a resolution before the board to compel the Buffalo Railway Company, the Crosstown Street Railway Company and the Buffalo Traction Company to sell eight tickets for 25 cents for passage over their lines between 5 and 8 A. M. and 5 and 8 P. M.

CLINTON, MASS.—Fifteen business men of this vicinity have announced their intention of forming a corporation to be known as the Clinton & Hudson Street Railway Company, for the purpose of constructing and operating an electric road between Clinton and Hudson, through the town of Berlin.

WORCESTER, MASS.—The first actual work toward the permanent construction of the Webster & Dudley Electric Street Railroad has been commenced at Webster. Although the contract does not call for completion till June 1, there is now no doubt the road will be in operation before that time.

BRIDGEPORT, CONN.—The Shelton Street Railway Company will be obliged to resort to condemnation proceedings to secure possession of the land needed for the construction of the extension through the upper portion of the town of Stratford. The owners, who have refused big prices, refuse to compromise.

DETROIT, MICH.—The Westinghouse Electric & Manufacturing Company is to supply the electrical apparatus for the new plant of the Detroit, Ypsilanti & Ann Arbor Railroad Company, consisting of four 300-hp generators, three boosters, switchboards, and ten car equipments, including forty 50-hp motors.

NEW YORK CITY.—Inside of a year the Third Avenue surface railway and

its branches, now operated by cable or horses, will probably be equipped throughout with an underground electric system. The Third Avenue road has between 70 and 80 miles of track, and the change will cost, it is estimated, at least $5,000,000.

STOCKTON, N. J.—The Council has granted a franchise to the Camden & Surburban Railway Company to operate lines on Westfield Avenue and River Road. The company refused to accept the franchise unless the sprinkling ordinance was repealed. This matter has been agitated for several weeks, and before adjourning the obnoxious ordinance was repealed.

WILKESBARRE, PA.—President John Graham, of the Wilkesbarre & Northern Railroad Company, which for a year past has been operating between this city and Harvey's Lake, has executed contracts for the electrical equipment of this road between Luzerne borough and the lake. The cost of the work will be about $50,000, and the contract calls for the completion of the work by June 15.

PHILADELPHIA, PA.—The Allentown & Kutztown Traction Company, to connect those towns by trolley, has been organized. The road will be 18 miles in length, and work on its construction will be commenced as soon as the bids can be advertised and the contract awarded. The estimated cost of the road, completed and equipped, will be about $180,000. Steel rails and stone ballast will be used, so that rapid running may be permitted.

NEW YORK CITY.—The Mount Vernon Common Council has received a petition from the New York, Westchester & Connecticut Traction Company for a franchise for several miles of streets. This action is thought to indicate that the company intends to urge opposition against the Union Railroad, which now has undisputed sway in Mount Vernon, Pelham and New Rochelle.

UNIONTOWN, PA.—At a special meeting the Uniontown Electric Railroad Company decided to build an extension to the Stewart coke plant, Cool Springs Hollow. A committee was appointed to look after the work, which will be commenced this week. The branch will connect with the park terminus, and will be extended on to Lamont and Youngstown this season.

COHOES, N. Y.—The State Railroad Commission has approved of an increase in the capital stock of the Stillwater & Mechanicville Street Railroad Company from $60,000 to $250,000. The increase is to be used by the company in the construction of a new line, to run from Mechanicville to Waterford, there to connect with the Troy Railway. This is taken to mean that it is only a question of time when an electric through line will extend from Troy and Albany to Saratoga Springs.

BROOKLYN, N. Y.—The Brooklyn "L" management has decided to operate all trains from the Bridge Street station, on Myrtle Avenue, to and from the bridge, by means of motor cars. When the connections have all been made for running the "L" cars over the bridge—and these are expected to be completed by June—all of the trains that are to be run over the bridge will be brought to the Bridge Street station, on Myrtle Avenue, by steam and from there carried to the Brooklyn end of the bridge by the motor cars and thence across by the bridge cable.

PITTSBURG, PA.—The recording on April 21 of a mortgage for $1,500,000, made by the West End Traction Company to the Union Trust Company, brought to light the reorganization of all the traction lines to West End, Crafton, Carnegie, Neville Island and Coraopolis, under the name of the West End Traction Company. A line will be built to Banksville, a number of extensions will be made, the Neville Island line will be double-tracked and improvements in rolling stock and roadway will be made, involving the expenditure of probably $500,000.

DOVER, DEL.—The Delaware Electric Railway Company, composed of the Dover & Milford Company and the Dover & Bay Shore, has about closed a contract to build a trolley road between Milford, Dover and Woodland Beach. It is expected that work will be commenced within two weeks. The entire route, as surveyed, will be 38 miles in length, including turnouts. It will begin at Milford and pass through Frederica, Magnolia, Rising Sun, Camden, Dover and Leipsic, the terminal being at Woodland Beach, where connections will be made with a line of steamers to Philadelphia and Wilmington.

DELAWARE, OHIO.—All of the property of every kind and description owned by the Delaware Electric Street Railway Company will be offered for public sale by the receiver of the company on May 16. The sale will include all rights and franchises, apparatus, cars, etc., and every right, title and interest which the company has or owns. The entire property is to be sold as a whole at not less than two-thirds of its appraised value, which is set at $27,000. Before any bid is accepted the bidder must deposit with the receiver an approved certified check for $1000 or $1000 in cash. Mr. John A. Cone is the receiver.

Legal Notes.

THE EDISON ELECTRIC LIGHT COMPANY v. THE E. G. BERNARD COMPANY.—Judge Coxe, in the United States Circuit Court, recently rendered a decision in the suit of the Edison Electric Light Company v. the E. G. Bernard Company, on patent No. 264,668, for the compound winding of a dynamo, dismissing the complaint. The Edison patent is declared to be invalidated by the patent granted to Mr. Charles F. Brush, No. 217,677, for the same improvement, some three years prior to Mr. Edison's patent. The decision is quite far-reaching, since the General Electric Company sought to extend the scope of the patent to cover any compound-wound dynamo, whether separately or self-excited, supplying circuits for any purpose whatever. Although the patent would soon expire by limitation, the date of granting being September 19, 1882, the action was commenced in 1893. The record contains over 2400 printed pages and the briefs 800 pages, although, as Judge Coxe states, the real issue is one of the simplest that can arise in a patent cause, namely, whether or not the patent is invalidated by a single prior patent. Edison's claims cover compound winding practically as it is known to-day, the earlier claims of Mr. Brush being for what was then known as a "teaser" coil, being an auxiliary shunt winding on the ordinary series machines of that date, for maintaining the excitation on high external resistances and for preventing reversal of the field magnetization in electroplating work. The attorneys for the complainant were Messrs. Edmund Wetmore and Richard N. Dyer, and for the defendants, Messrs. Henry A. Seymour, Robert S. Taylor, Charles A. Brown and Seward Davis.

Personal Notes.

MR. CHARLES F. CROSELMIRE, of Newark, N. J., will give a complimentary dinner to his old regiment, the First New Jersey Cavalry, and friends, at Davis's dining parlors, 943 Broad Street, Newark, N. J., 7 o'clock Saturday evening, May 21.

MR. H. M. SALMONY, managing director of H. M. Salmony & Co., Ltd., London, Eng., is in New York, stopping at the Hoffman House. He will be glad to hear from anyone in the electrical line having anything new, with the object of making agency arrangements. Any communication to Mr. Salmony in care of the Hoffman House will reach him.

Trade and Miscellaneous Publications.

THE NOWOTNY ELECTRIC COMPANY, Cincinnati, Ohio, has issued a pamphlet describing its long burning enclosed arc lamp. The mechanism of the lamp is well illustrated.

THE RIDGELY & JOHNSON TOOL COMPANY, Springfield, Ill., in a neat catalogue of recent issue, describes and illustrates its pneumatic hammers for chipping, calking, heading and riveting.

THE TECHNIC ELECTRICAL WORKS, Philadelphia, Pa., has issued two pocket price lists, one of isolated plant switchboards and the other of knife switches. The price lists are complete and concise, and their contents will be of deep interest to engineers, dynamo builders and supply houses.

"FRINK'S REFLECTORS" is the title of a pamphlet issued by I. P. Frink, 551 Pearl Street, New York. All styles of Frink's reflectors and reflecting fixtures are illustrated and described. A long list of testimonials is given at the back of the catalogue, which contains ninety-six pages.

THE BUCKEYE special coil filament incandescent lamp has a reputation among lamp consumers as being one of the best on the market. A new catalogue showing the new shapes, styles, etc., has just been issued by the Buckeye Electric Company, Cleveland, Ohio. Mr. J. H. Cooke, 753 Monadnock Building, Chicago, is issuing catalogues, etc. to the trade.

BULLETIN 1-F of the Western Electric Company, Chicago, which is just issued, brings out the main points of the company's alternating current fan motors, and also illustrates the machine. The company has also recently issued Bulletin No. 8001, which gives a comprehensive description of its arc dynamo regulator. The various parts of the device are clearly illustrated.

MR. GEORGE W. LORD, 316 Union Street, Philadelphia, Pa., has just issued a circular on the subject of Lord's Boiler Compounds. It contains information of great interest to steam users. The essays upon boiler incrustation and corrosion published in pamphlet form by Mr. Lord also contain matter of deep interest to engineers.

THE WALKER COMPANY has just issued four circulars, Nos. 1074, 1075, 1076 and 1077, respectively. The first is on the subject of railway switchboards; 1075 is devoted to the Walker railway underground conduit; 1076 relates to switchboards for lighting plants, and 1077 gives a description of the Walker pivotal trolley and Grover trolley head. The different apparatus are completely illustrated.

THE WAR WITH SPAIN is the most absorbing subject that occupies the minds of the people at the present time. Messrs. Rand, McNally & Co., Chicago and New York, have issued a war atlas which no doubt will meet with a rapid sale. Maps of the world, North America, Europe, Spain, the West Indies, Cuba, Havana, the Philippines, etc., are given on a scale large enough to be valuable for ready reference.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, manufacturer of high-grade "Anti-Trust" incandescent lamps, has just issued in pamphlet form "an invitation to its christening." The company in this pamphlet calls attention to the fact that it has been its custom for some years to print on the label which is placed on its incandescent lamps its full name and address. In this way its lamp has become known as the "Warren lamp" and the company as the "Warren Company," but inasmuch as there are other lamp manufacturers in Warren the Warren Electric & Specialty Company has felt it incumbent upon itself to choose a distinctive name for its incandescent lamp, by which the lamp shall be known hereafter. In order to carry out this purpose it has decided to offer prizes for the best and most appropriate name for its lamp, and invites its patrons to decide the matter for it. The first prize for the name which the judges decide is the best and most appropriate will be $50; second best, $30; third best, $20; fourth best, $10. The contest will be open from May 1 to November 1 this year. The pamphlet calls attention to the good points of the lamp.

Trade and Industrial Notes.

THE CHICAGO OFFICE of the Stilwell-Bierce & Smith-Vaile Company has been moved to 311 Dearborn Street.

THE ILLINOIS ELECTRIC COMPANY, Chicago, Ill., advises the trade that it has a complete line of Crefeld weatherproof, annunciator, office, magnet wires, etc.

MESSRS. CRAGE & TENCH, Buffalo, N. Y., have been awarded the contract for the construction of the Buffalo, Hamburg & Aurora Electric Railway. The power house and the Hamburg division will be built first.

THE MARYLAND TELEPHONE MANUFACTURING COMPANY has opened an office in New York at No. 130 Fulton Street. Mr. Paul Minnis is the manager.

THE STERLING VARNISH COMPANY, Pittsburg, Pa., announces the opening of a branch house in Birmingham, England. A full stock of goods will be carried at the new agency for the benefit of the company's European customers.

MR. FRANK R. EAGER, sales agent at Syracuse for the Jandus Electric Company, has just placed twenty-six Jandus long-burning arc lamps in the Kirk Building, Syracuse, N. Y. The Jandus lamp, Mr. Eager states, takes the lead in Syracuse.

MESSRS. HUEBEL & MANGER, Brooklyn, N. Y., are doing well with their patented water-tight push button. They have received several large orders for this device. These push buttons, together with their skeleton bells, make an excellent signal system for naval vessels.

THE PARIS EXPOSITION.—Those who desire to obtain information regarding exhibits at the International Exposition, which will be held in Paris, France, in 1900, can be enlightened on these matters by applying to Mr. Sidney J. Manby, 20 East Twenty-ninth Street, New York, or to J. E. Lamaille & Co., Paris.

THE CITY OF UNION SPRINGS, Ala., is about to install an electric light plant. The Ball Engine Company, Erie, Pa., will furnish the engine. Mr. Charles Doughty, of Randolph, Mass., recently ordered for his electric light plant at that place a 200-hp vertical cross-compound engine direct connected to a 120-kw generator. The engine is furnished by the Ball Engine Company, of Erie, Pa.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., has designed fan motors that are to be connected up directly with 220 or 550 volt circuits without the intervention of any resistance. This company states that three of its 110-volt motors or two of the 220-volt motors can be run in series on 550-volt circuits, and the 550-volt motor can be placed on 600-volt circuits.

THE AMERICAN TOOL WORKS, Cincinnati, Ohio, reports that the demand for machinery in foreign countries is still steady, notwithstanding the fact that hostilities between this country and Spain have begun. The company has during the past week received a number of orders through its London office for brass working and other machinery; also an order for a number of standard engine lathes, drill presses and shapers.

THE STEPHENSON MANUFACTURING COMPANY, Albany, N. Y., has issued a set of four business men's postal cards, on which it calls attention to the advantages of the Stephenson belt dressing. This dressing is said to preserve belts and prevent their slipping. It is moulded into one-pound sticks and is applied to the belt by friction. A list of recent purchasers of this belt dressing is given on the cards.

THE ORIENT ELECTRICAL COMPANY, Youngstown, Ohio, states that there is an increasing demand for its high grade incandescent lamps, which in itself is a guarantee of their satisfactory quality. The company is establishing a desirable trade abroad for its product, which is favorably known in this country. It has been for some time making regular shipments to Brazil, and recently booked another order for that country.

THE AMERICAN DISTRICT STEAM COMPANY, Lockport, N. Y., has commenced the construction of an exhaust steam heating plant for the Home Heating Company, of Erie, Pa. The cost of the plant will be in the neighborhood of $50,000, and the exhaust steam will be supplied by the Merchants and Manufacturers Electric Light Company, and the Erie Electric Motor Company, combined. This will give a continuous day and night supply of steam, which, it is expected, will heat 8,000,000 to 10,000,000 cubic feet of space the first season.

THE HOLMES-ROSE ELECTRICAL COMPANY is the title of a new firm of electrical engineers and contractors in Baltimore, with headquarters at 215 North Calvert Street. The members of the new concern are Messrs. W. H. Rose, M. E., and G. R. Holmes. Mr. Holmes has been associated with David E. Evans & Co., Baltimore, for the past eight years. Mr. Rose is a graduate of Cornell University of the class of '97. The firm will carry on a business of repairing and installing electrical apparatus, fan motors, pumps, etc., in addition to its electrical engineering and contracting.

ADDITION TO THE CARNEGIE PLANT.—The power plant of the Carnegie Steel Company's Edgar Thomson mill is to be enlarged by the addition of apparatus from the Westinghouse Electric & Manufacturing Company. The new generator is to be the Westinghouse standard 800-kw, 250-volt, 85 r. p. m. engine-type machine. It will be direct connected to a vertical Allis-Corliss engine, and will operate in multiple with two 400-kw Westinghouse generators already installed. The present switchboard is to be enlarged by the addition of a new generator panel to provide for the operation of the new machinery.

THE A. A. GRIFFIN IRON COMPANY, Jersey City, N. J., has just received an order for one No. 78 and one No. 79 Bundy high pressure separating tank steam traps, through a firm of New York forwarding agents, to go to a large electric light plant at Maracaibo, Venezuela, where they are to be used for draining the reheaters of a Westinghouse engine. The A. A. Griffin Company has issued a book containing a full line of descriptive illustrations and many valuable hints regarding the application and benefits to be derived from the use of its steam and oil separators, and will be pleased to send a copy to anyone on application.

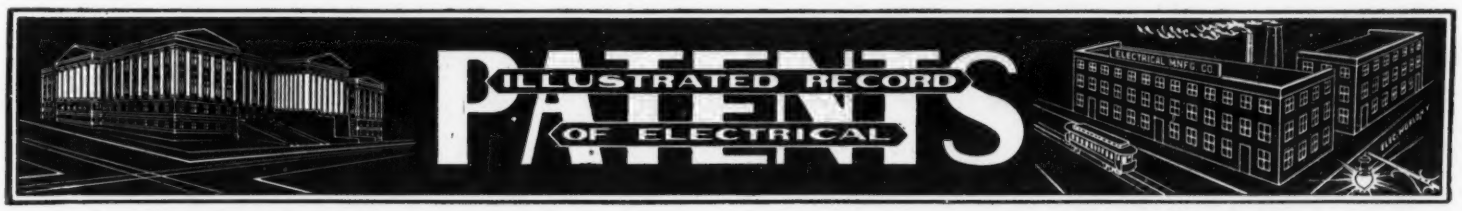
MESSRS. J. B. COLT & CO., Nos. 3-7 West Twenty-ninth Street, New York, calls attention to the "Criterion" acetylene gas generator which this firm manufactures. A quantity of calcium carbide is placed in the holder of the generator, water is introduced and the gas immediately results. One acetylene gas burner, it is said, consumes one-half foot per hour, and gives twice as much light as a coal gas burner consuming five feet per hour. Anyone not near a regular gas system can have, for little money, an acetylene gas plant of his own anywhere on the premises. A plant that will run fifteen or twenty lights evening after evening it is claimed gives less trouble than a single kerosene lamp.

THE NEW AIR-TIGHT open-circuit battery called the Badt hermetic cell is receiving the approbation of many engineers and electricians who have been obliged to deal with the troublesome question of primary batteries. The oil seal, which so positively prevents the evaporation of the liquid, the creeping of salts and the constant premature disintegration of zincs, is the latest novelty in batteries, and is a feature which strongly recommends this cell for use. The Western Electric Company, Chicago, which recently announced that it was headquarters for batteries of various kinds, desires to state that the Badt hermetic cell is also added to its list of batteries.

A FRENCH TYPE OF BRUSHES.—A lubricating commutator brush is described in a pamphlet recently published by Fabius Henrion, of Nancy, France. This brush is made up of thin aluminum leaves bound together with a seamless netting of woven aluminum wire. Finely powdered graphite is placed between the leaves, the combination of the soft metal and the lubrication giving a high finish to the commutator as well as a soft and flexible brush. The same house also furnishes a superior line of arc light carbons. These are made up in two grades, one of increased hardness and duration of life for open arc lamps, and another softer, intended to burn without any residue, for alternating and enclosed arcs. The standard economy of incandescent lamps made by the same concern is now three watts per candle, although on special orders two-and-one-half watt lamps can be supplied. High voltage lamps up to 250 volts are also made.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.



UNITED STATES PATENTS ISSUED MAY 10, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

603,623. CONDUIT WIRING MACHINE; W. E. Cowan, Brooklyn, N. Y. App. filed Aug. 27, 1897. In a conduit wiring machine, a guide section, runners thereon, a rope carrying section, a rod and clutches whereby each of the aforesaid sections may be rigidly attached to the interior of a conduit, and means whereby the sections may be alternately introduced within said conduit by means of said rod, and means whereby said clutches can be withdrawn from contact with the conduit.

603,624. ELECTRIC RAILWAY; E. C. Crocker, Bridgeport, Conn. App. filed Sept. 17, 1897. This invention relates to improvements in electric railways which employ insulated rail sections from which the electrical current is collected by the car, said rail sections being electrically connected with and disconnected from the supply conductor through switches interposed between said conductor and the respective rail sections.

603,625. ELECTRIC RAILWAY; E. C. Crocker and E. C. Howe, Bridgeport, Conn. App. filed Sept. 17, 1897. In an electric railway system which comprises a supply conductor, insulated third-rail sections and a power collector carried by the car, the two series of magnets, each series comprising pairs of separate magnets, arranged opposite each other, single magnets selected from each quaternate couplet of one series being connected in circuit with single magnets selected from alternate couplets of the other series intervening between said quaternate couplets, whereby branch circuits are formed, and connections with said conductor and sections through intermediate circuit closers and breakers operated by said magnets whereby the section having contact with the collector is in closed circuit, while the sections immediately succeeding and preceding are in circuits capable of being closed by the collector.

603,630. ELECTRIC ARC LAMP; F. A. Gilbert, Brooklyn, and Emil O. Lundin, Beachmont, Mass. App. filed July 1, 1897. In an arc lamp, a feed controlling clutch, including rotatable members to directly engage the carbon, rocking carriers for said members, brakes mounted on the carriers to prevent rotation of and press said members against the carbon, and an actuator to operate the carriers and control the brakes to thereby raise and lower the clutch bodily.

603,656. CONDUIT FOR RAILROADS; F. S. Pearson, Boston, Mass. App. filed Sept. 14, 1897. In a conduit for railroads, in combination, a trap in the top of the conduit; mechanism by which the trap is opened and closed, and an actuator arranged to be depressed by the car wheel, whereby the trap mechanism is operated.

603,665. CONTROL APPARATUS FOR ELEVATORS; A. Sundt, New York, N. Y. App. filed April 24, 1897. In an elevator control device, the combination with the motor and working circuit therefor, of local circuits operated from the car or floor, and a non-interfering locking device operated by a local circuit and released by the motor.

603,672. TROLLEY DEVICE FOR ELECTRIC RAILWAY CARS; L. E. Walkins, Springfield, Mass. App. filed April 14, 1897. The combination

with an overhead support or conduit, having upper and lower ways or conductors, of a trolley having a wheeled body running on the lower conductor, and having a spring supported shoe to run with an upwardly bearing pressure on the upper conductor, the car having upright arms one in advance of the other, each pivotally connected on the car for fore-and-aft vibrations, and each having adjacent its pivot an angular arm, cushions above and below said arms and connections between the arms and the ends of the trolley body.

603,681. THROW-OFF SWITCH FOR TELEPHONES; N. Fallek, San Francisco, Cal. App. filed Aug. 17, 1897. The combination with a pivotally attached switch lever, of a spring, a ratchet-toothed bar, a sliding dog, a spring arm, a pivoted lever, a pivoted piece, on the end of said lever and an arm on the telephone hook, having inclines on the end to engage the inclines on said piece.

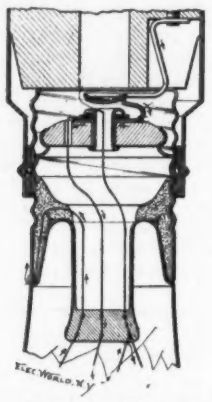
603,687. ELECTRIC ARC LAMP; J. H. J. Haines, New York, N. Y. App. filed May 27, 1897. The combination of the annular base plate, the outer globe supported thereon, the removable ring for sustaining the globe, an arc enclosing chamber mounted directly upon said plate over the opening therein, and a removable plate closing said opening and carrying the lower carbon holder.

603,705. ELECTRIC INCANDESCENT LAMP; W. J. Phelps, Chicago, Ill. App. filed Sept. 7, 1897. An electric incandescent lamp comprising a vacuum bulb, two sections of incandescing material, one of said sections serving as a resistance to modify the current for the other section when in series therewith, but being of too low resistance to be independently subjected to the full voltage of the electric supply, and connections whereby current may be passed to both sections in series or through the section of higher resistance alone, but not through the section of lower resistance alone.

603,709. DYNAMO OR MOTOR; F. Schwedtmann, St. Louis, Mo. App. filed Oct. 23, 1897. In a dynamo or motor, a suitable casing or housing for the field magnet core cast in one piece, a laminated field magnet core inserted in said casing from the bottom, and means for rigidly securing said core in said casing.

603,722. ELECTRIC CONDENSER; C. S. Bradley, Avon, N. Y. App. filed July 29, 1897. An electric condenser having as a dielectric stearate of lead.

603,745. UNDERGROUND CONDUIT FOR ELECTRIC CONDUCTORS; C. H. Sewall, Chicago, Ill. App. filed May 8, 1895. As a conduit for electrical conductors a plurality of inverted channels made in separate and



No. 603,705.—Electric Incandescent Lamp.

single sections, said sections resting upon a flat foundation floor, which, with the inverted channels, form duct openings; and the said channels supporting other floors, each one sustaining its complement of inverted channels, whereby the conduit can be made of any width or height and contain any number of ducts.

603,778. STARTING DEVICE; J. P. Stone, Schenectady, N. Y., and S. Everett Doane, Marlborough, Mass. App. filed Oct. 22, 1897. At starting device for a single-phase alternating current motor, comprising two-phase displacing devices in series across the mains, and in shunt to the motor, one of the phase displacing devices designed to deliver from a point between the phase displacing devices to a third terminal of the motor a higher than normal voltage.

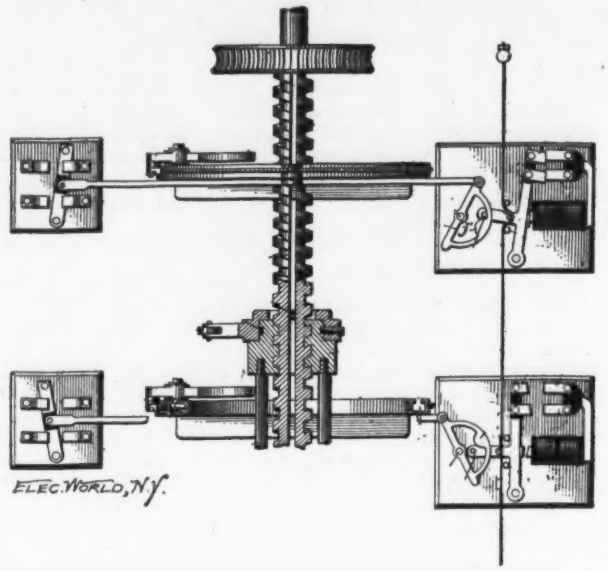
603,779. RAIL JOINT; J. Wayland, Newark, N. J. App. filed Jan. 22, 1898. A bed plate for an insulated rail joint, having a plane floor, vertical longitudinal side ribs of different height integral therewith and projecting lateral flanges notched to receive spikes, an insulating shim confined between the ribs, and a coupling block bearing on the shim and overlapping the low rib.

603,786. ELECTRICALLY CONTROLLED SWITCH; E. M. Hewlett, Schenectady, N. Y. App. filed Jan. 23, 1897. In a system of distribution, the combination of supply and back mains, a single auxiliary main extending from the point of control, as, for example, a supply or sub-station, to a switch for opening and closing the circuit between the supply and back mains, an electromagnetically controlled switch, comprising a pair of electromagnets, each having a coil permanently connected to a supply main at one end, and alternately connected to the auxiliary main by an automatic switch.

603,815. ELECTRO-THERAPEUTIC APPARATUS; G. G. Duke, Chicago, Ill. App. filed Dec. 6, 1897. The combination of an open-ended metallic casing, provided with a jet or orifice or orifices, and with a marginal flange of insulating material, an outlet tube leading from said casing inside of said flange and a primary battery or other source of electrical supply, one terminal of which is electrically connected with said metallic casing and the other terminal of which is provided with an electrode.

603,849. SWITCH FOR ELECTRIC MOTORS; F. E. Herdman, Winnetka, Ill. App. filed Jan. 9, 1897. A switch for an electric motor to prevent sparking of the fields and also prevent sparking from opening outside circuit; also a switch which will snap close as well as open.

603,875. ELECTRICAL APPARATUS FOR SCHOOLS; M. E. Crowell, Indianapolis, Ind. App. filed Nov. 23, 1896. This invention consists of a combination of pieces or parts so formed and adapted with relation to each other as to enable an instructor or pupil to quickly arrange them into various electrical devices as he may desire.



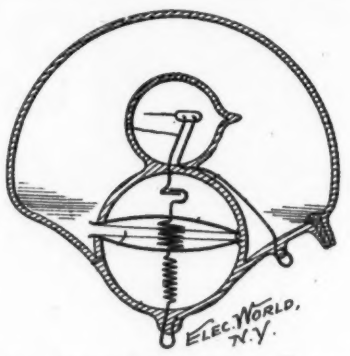
No. 603,665.—Control Apparatus for Elevators.

603,882. ELECTRIC LANTERN; F. G. W. J. Adams, London, Eng. App. filed April 24, 1897. In an electric lantern, the combination with a casing having partitions of blocks at the bottom of the casing, electrodes with insulating stops, wedges for securing the electrodes, an overlapping cover provided with a metal strip, contact pegs, conductors and a sliding front covering the conductors and carrying the lamp and fittings.

603,883. SAFETY INCANDESCENT ELECTRIC LAMP; F. G. W. J. Adams, London, England. App. filed May 10, 1897. An electric safety lamp, consisting of the lamp proper, which is provided with a glass chamber inclosing the lamp and joined thereto by a fusion of the glass and an automatic circuit breaker becoming active upon breakage of the inclosing chamber.

603,886. ELECTRICAL STEERING APPARATUS; H. O. F. Bindemann, Madrid, Spain. App. filed June 4, 1897. Apparatus for electrically steering a vessel, to be used as a substitute for the steam steering apparatus ordinarily used.

603,890. PRIMARY ELEMENT WITH REGENERABLE NEGATIVE ELECTRODE; O. R. E. Von Burgwall and L. Ofenschussl, Vienna, Austria-Hungary. App. filed Dec. 9, 1896. The process of manufacturing negative electrodes for primary batteries, consisting in first preparing a peroxide plate of porous peroxide of lead on a lead fame, then freeing this plate of air and moisture, then impregnating the peroxide with a water soluble con-



No. 603,883.—Safety Incandescent Electric Lamp.

centrated electrolyte and then partially drying the electrodes so that they present dry surfaces.

603,898. ALARM; I. B. Frazee, Blairstown, Ia. App. filed March 6, 1897. The combination of an electromagnet, an armature arm pivotally mounted adjacent to the electromagnet, an arm pivotally mounted above and bearing on the armature arm, and a spring-pressed block bearing against one edge of the armature arm and capable of engaging either side of the armature arm, according to the position to which said arm moves.

603,991. CABLE-STRINGER; F. A. Cannon, Denver, Col. App. filed Dec. 3, 1897. The combination with suitable means for supporting the cable and suspension wire, of a bracket adapted to be attached to said means, and a roller journaled on said bracket, and adapted to engage the cable, the bracket being provided adjacent the roller with a ledge for supporting the suspension wire.